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Turret Head Axle Machine.

The accompanying cut represents a turret head axle machine, specially designed for drilling, facing, and tapping axles made of gas pipes or other material, though it can be adapted to a variety of work. It will swing 17 inches in diameter; the cone pulleys have two speeds for a five inch belt, and it is back geared; it has a hollow spindle, to each end of which is secured a concentric chuck for holding the work; the chucks are 14 inches in diameter and will grip 3½ inch stock. The turret head is 12 inches in diameter, has a movement of 16 inches on the bed, and revolves automatically when the slide is moved back; it has six holes for inserting the tool holders. Provision is made for taking up the wear on the turret slide so as to keep it always in line with the spindle. The makers of this machine are the Betts Machine Company, Wilmington, Del.

Practical Drawing.

BY J. G. A. MEYER.

FIFTY-FIFTH PAPER.

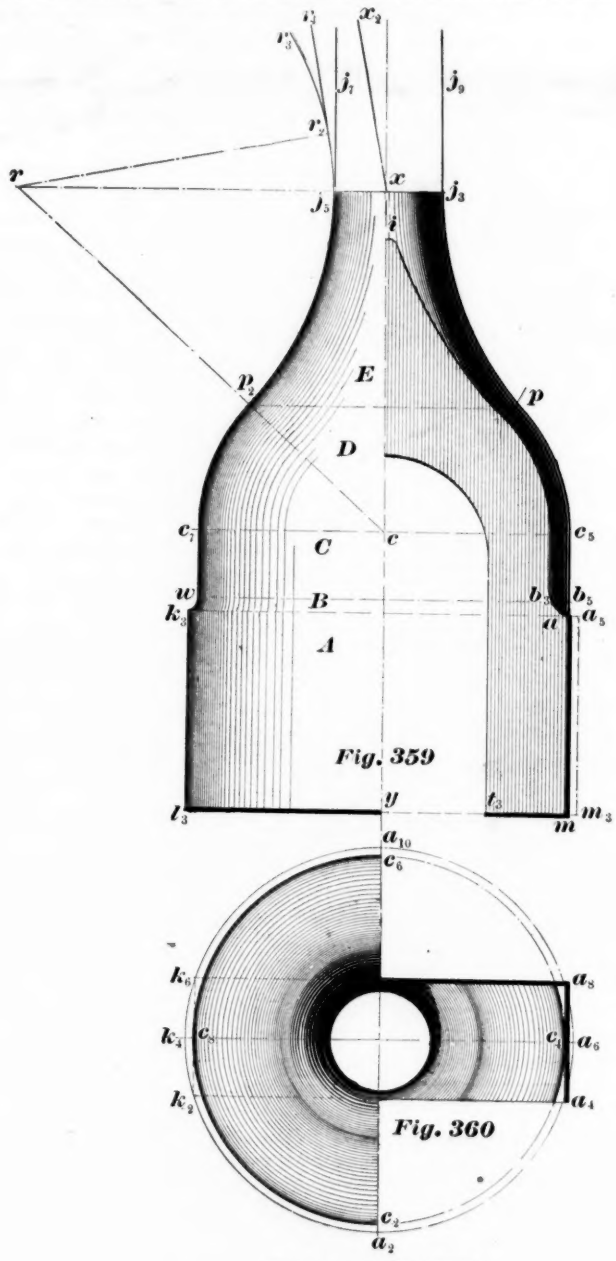
Problem 69—*Continued.*

Fig. 356. In our last paper we have briefly explained the method for finding the curve of intersection $c_3\ f_3\ i$ lying between the lines $i\ i_3$ and $c\ c_5$. We have now to show the manner of finding the lines of intersection between the horizontal lines $c\ c_5$ and $l_3\ m_3$. Through the center from which the small arc $a_5\ b_5$ has been described, draw a line $b\ b_5$ perpendicular to $x\ y$; also through the point c_3 draw a line $c_3\ b_3$ parallel to $x\ y$, and terminating in the line $b\ b_5$. The line $c_3\ b_3$ will be another portion of the intersection of the surface of revolution and the cutting plane; the latter being represented by the line $k_2\ a_4$ in Fig. 357. The curve of intersection $b_3\ a_7$ is found by the same method as that adopted for finding the curve $c_3\ f_3\ i$. That is to say, divide the distance between the lines $b\ b_5$ and $a\ a_5$ into two or three equal parts; through these divisions draw lines parallel to $a\ a_5$. Of course the distances between these lines will be very short, but this will in nowise interfere with the application of the methods already explained. On these lines lay off points in the curve of intersection $b_3\ a_7$, in a manner precisely similar to that adopted for finding points in the curve $c_3\ f_3\ i$. A curve drawn through the points thus found will be the required curve of intersection $b_3\ a_3$. On account of the arc $b_5\ a_5$ being so small, great care will be required to determine accurately the true form of the intersection $b_3\ a_3$. In small drawings, or drawings made to a small scale, it is not necessary to show the true form of this curve, and therefore the curve $b_3\ a_3$ is generally represented by an arc of a circle, thereby avoiding the labor of finding the true form of this curve.

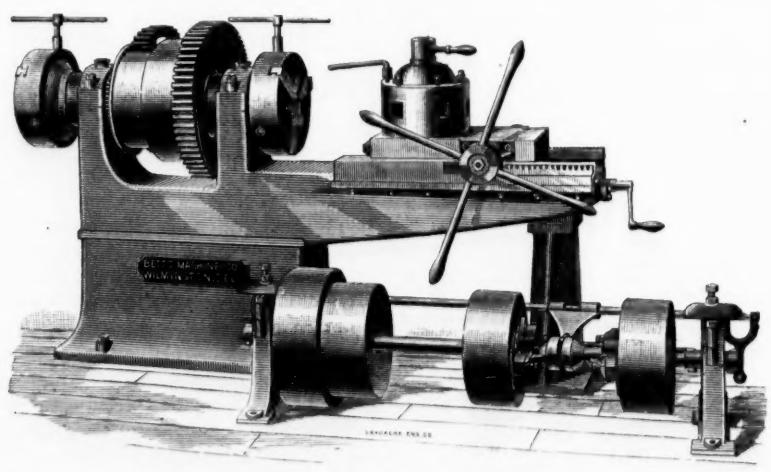
The straight lines $a_3\ m$ and $k\ l$ have already been found, and represent edges of the fork-ends. Hence our problem, as far as Fig. 356 goes, is completed.

476. *To find the intersection* $k_5\ b_7\ k_7$ *in Fig.* 358.

The lines of intersection $k_5\ b_7\ k_7$ are formed by passing through the surface of revolution, one of the cutting planes represented in Fig. 357 by the lines $k_2\ k_6$ and $a_4\ a_8$. Now notice that, in Fig. 357, the lines $k_2\ k_6$ and $a_4\ a_8$ are tangent to the circle $c_2\ c_4\ c_6\ c_8$; consequently the curves of intersection $k_5\ b_7\ k_7$, in Fig. 358, will not form a continuous curve, such as $g\ a_5\ k$, shown in Fig. 348, but will meet abruptly in a point, similar to the curve $g\ a_5\ k$ in Fig. 343. The method for finding the curve $k_5\ b_7\ k_7$, in Fig. 358, is precisely the same as that adopted for finding the curves of intersection $g\ a_5\ k$ in Fig. 343, and has been explained in Prob. 66; consequently nothing further relating to the construction for finding the curves of intersection in Fig. 358 need be said. Of course the vertical distance between the point b_7 and the points $k_5\ k_7$, in Fig. 358, is very short, and consequently, the horizontal lines which must be drawn (and which will correspond to the horizontal lines $b\ b_3$, $c\ c_3$, etc., in Fig. 343) will be very close together; but this in no wise changes the method given in Prob. 66, and which, as we have stated before, is applicable to the case before us.



PRACTICAL DRAWING.



TURRET HEAD AXLE MACHINE.

477. The importance of these lines of intersection, and similar intersections in other solids, also the practical advantages which may often be gained by them, and therefore the necessity of avoiding mistakes, and to know how to draw these lines of intersection accurately, leads us to recapitulate the principles involved in this problem, and further illustrate them in Figs. 359 and 360, in which the letters indicate lines which correspond to the lines similarly lettered in Figs. 356 and 357. The right-hand sides of Figs. 359 and 360 represent the fork-end cut out of a solid, which is represented by the left-hand side of both figures.

In the first place, we have reduced our fork-end to a geometrical figure, as shown by the left-hand side of Fig. 359; or, in other words, we have assumed our fork-end to be a portion of a solid whose surface is generated by the straight line $a_5\ m_3$, the arc b_5-a_5 or $w\ k_3$, the straight line $c_5\ b_5$, and the arcs $c_5\ p$, and $p\ j_3$, all revolving around the axis $x\ y$. The straight line $a_5\ m_3$ generates a cylindrical surface (see Arts. 291, 451); this surface, marked A, extends from the line $l_3\ m_3$ to the line $k_3\ a_5$, and is represented in Fig. 360 by the circumference $a_2\ a_6\ a_{10}\ k_4$. The arc $b_5\ a_5$ generates a double curved surface (Art. 451). This surface, marked B, extends from the line $k_3\ a_5$ to the line $w\ b_5$. The straight line $c_5\ b_5$ generates another cylindrical surface (or single curved surface, see Art. 451). This surface, marked C, extends from the line $w\ b_5$ to the line $c_7\ c_5$. The position of the line $w\ b_5$ is determined by the point of tangency b_5, through which it is drawn; so also the position of the line $c_7\ c_5$ is determined by the point of tangency c_5, through which this line is drawn. This cylindrical surface is represented in Fig. 360 by the circumference $c_2\ c_4\ c_6\ c_8$. The arcs $c_5\ p$ and $p\ j_5$ generate the remaining portion of the surface of revolution. That part of the surface generated by the arc $c_5\ p$, marked D, extends from the line $c_7\ c_5$ to the line $p\ p_2$; this latter line is drawn through the point of tangency p; and, lastly, the portion of the double curved surface, marked E, generated by the arc $p\ j_5$, extends from the line $p\ p_2$ to the line $j_5\ j_3$; the latter line is part of the horizontal line drawn through the center r.

Through this surface of revolution cutting planes are passed. These cutting planes are represented in Fig. 360 by the lines $k_2\ a_4$, $k_6\ a_8$, $k_2\ k_6$, and $a_4\ a_8$. These lines, on a working drawing, represent the outer surfaces of the rectangular portion of the fork-end. In short, practically speaking, we have assumed the end of the rod to be an enlarged stub-end turned to the required shape, and then the portions of this stub-end, lying outside of the lines $k_2\ a_4$, $k_6\ a_8$, $k_2\ k_6$, and $a_4\ a_8$ cut off; the edges thereby formed are represented by the lines of intersection found by construction in our problem.

Directions.—In space marked Prob. 69 draw a fork-end, such as shown in Figs. 356, 357 and 359, according to the dimensions there given. Find the lines of intersection $a_7\ b_3\ c_3\ f_3\ i$ accurately. Use a 1½ inch scale. To save room, the circles and arcs in Fig. 357 need not be drawn outside of the lines $k_6\ a_8$ and $k_2\ a_4$. Before drawing the fork-end to this small scale it will be best to make a complete drawing of it in pen-

cil, full size. This will be good practice for the student, and enable him to do better work afterwards.

478. Frequently, in machine shops, before a connecting-rod having a fork-end like that shown in Fig. 356 is turned to the dimensions given, it is planed to size, and then on one of its surfaces the curve of intersection a_7 b_3 c_3 f_3 i is correctly drawn. The connecting-rod is then turned to this curve, bringing it to the required form without the use of any templets. Here then we see the utility of knowing how to lay out such a curve, and the principles involved.

479. *To find the junction of the double curved surface E, and the rod whose diameter in the center of its length is greater than the diameters at the ends.*

In Art. 477 it is stated that the double curved surface marked E (Fig. 359), generated by the arc $p\,j_5$, extends from the line $p\ p_2$ to the line $j_5\,j_3$, the latter line is part of the horizontal line drawn through the center r. This is only true for rods which are turned straight above the line $j_5 j_3$, as represented by the lines $j_5\ j_7$ and $j_3\ j_9$. But in the majority of cases the rod is turned tapered, that is to say, the rod is larger in diameter at the center of its length than at the ends. In such cases, the small diameter as well as the large diameter of the rod are given, and also the condition that the double curved surface marked E shall be tangent to the tapered surface of the rod. To make a drawing which shall fulfill these conditions, we proceed as follows:

Draw two lines $j_5\ j_7$ and $j_3\,j_9$ at equal distances from and parallel to the center line $x\ y$; the distance between the lines $j_5\,j_7$ and $j_3\ j_9$ must be equal to the small diameter of the rod, in this case six inches. Then find the center r and describe the arc $p_2\ j_5$ tangent to the arc $c_7\ p_2$, and also tangent to the straight line $j_5\,j_7$, and prolong the arc beyond the line $j_5\,j_3$ to any convenient distance, say up to the point r_3. So far our construction is precisely the same as in Fig. 356, with the exception that the arc $j_5\ p_2$ extends beyond the line $j_5\,j_3$. From any point, as x on the center line $x\ y$, draw a straight line $x\ x_2$ any length, to the correct taper of the rod. Through the center r draw a straight line $r\ r_2$ perpendicular to the line $x\ x_2$, and cutting the arc $p_2\ r_3$ in the point r_2. From the point r_2 draw a straight line $r_2\ r_4$ parallel to $x\ x_2$. In a similar manner the other side of the rod is treated. Here then we have a drawing of a tapered rod with fork-end which fulfills all the given conditions; that is to say, the small diameter of our rod, if correctly drawn, is exactly six inches, and the junction of the double curved surface E and the tapered part of the rod is not abrupt. The point r_2 is the point of tangency; that is, the point in which the straight line $r_2\ r_4$ touches the arc $p_2\ r_3$. The double curved surface E extends from the line $p\ p_2$ to the horizontal line drawn through the point of tangency r_3, and here the tapered part of the rod commences, and extends to the center of the rod.

Force in the Steam Engine and Its Relation to Smooth Running.

BY PROF. JOSEPH E. TORREY.

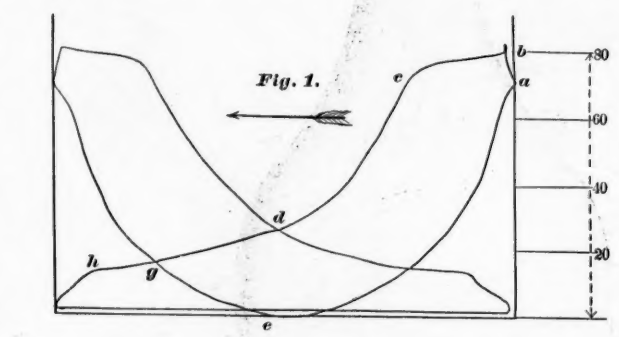
There are two classes of forces at work in the steam engine while it is running. The first class may be termed the *steam forces*. They arise from the varying effort of the steam on the piston in different parts of the stroke. This class is fairly well understood, though not well enough.

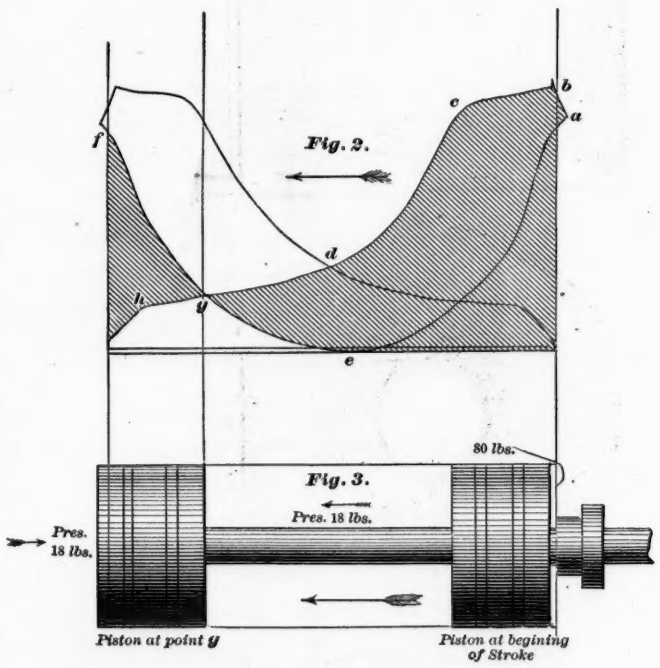
The other class is known as the *inertia forces*, though the name is not an altogether fortunate one. These forces arise from the momentum of the "reciprocating parts," *i.e.*, the piston, piston-rod, crosshead and connecting-rod. To put it in another way; at the beginning of the stroke there is a certain amount of force required to impart the required speed to these reciprocating parts. At the end of the stroke they are brought to rest, and, according to a well-known law in mechanics, give out, in being brought to rest, the same force that was expended in setting them in motion.

The nature of these forces, in their relation to the steam engine, is, in general very poorly understood by engineers and designers. Their actual operations and practical value is an unsolved question. Charles T. Porter and a few other men have done much toward a solution, but the results and effect on engine design are not great as yet. The present paper is an attempt to set forth fundamental principles, in as plain a manner as possible, in the hope that it may result in additional study of this important subject, by those who build and run steam engines, and who, consequently, have the opportunity of constant observation—the only key to a satisfactory solution.

It is proposed, then, to study first separately, and then together, the steam and inertia forces, and to point out simple ways of studying their amount and effect by the indicator diagram and otherwise. Many engineers will find nothing new here, but it is hoped that some young engineers will find some foundation on which to build future study.

There are three leading marks of a well-designed and built steam engine. (1.) Good steam economy. (2.) Large output in proportion to weight of engine. (3.) Quick and smooth running. The first of these points is usually made the most important. In reality, however, circumstances determine their relative value. In some localities steam economy is of relatively small importance, but durability and smooth running are essentials. In other cases lightness and compactness are all important. Smooth running is always important, and should be a prominent aim in every design.





FORCE IN THE STEAM ENGINE.

We will first consider the steam forces. They arise, as has been said, from the varying effort of the steam on the piston. The critical points in the stroke are the two ends. Then the pressure is transferred from one end of the piston to the other twice in every revolution. If this transfer is made suddenly, and if the pressure coming thus suddenly on the piston is mostly unbalanced pressure, the result will be the well-known disagreeable and disastrous "pound." "Tightening up" only affords a temporary remedy. No bearing can stand such blows, and the result is, at best, frequent necessity for shutting down and rebabbitting.

It is true that in every case the pressure is actually balanced or anticipated to a greater or less extent, but in a large majority of cases there is unbalanced pressure enough to cause very objectionable shocks.

I believe the magnitude of the shock which makes itself audible as a "pound," is insufficiently realized. Perhaps an illustration or two will help the matter. Consider an engine 18″ by 24″ making 250 R. P. M. At the beginning of the stroke, the total pressure on the piston, if the pressure in the steam chest is 80 pounds per square inch, will be a little over 20,000 pounds, or about *nine tons*. This is not, we will suppose, all unbalanced pressure. We will assume that one-half is neutralized. The speed assumed was 250 R. P. M. This is equal to one revolution in one-fourth sec. During this one-fourth sec. the piston travels 48″; consequently it would travel 1″ in $\frac{1}{192}$ sec. If we assume that the valve is opened full, for admission, within 5″ of piston travel, which is certainly a liberal allowance, a pressure of 4½ tons will be thrown on the piston in about $\frac{1}{40}$ sec. As Mr. Ed. F. Williams says: "Figures have no power to express the violence of such shocks."

In the case just considered, we were dealing with a rather high speed engine, but the evils of pounding are not confined to high speed. In fact, it is almost always true that the shock on passing centers is, in case of a low speed engine, more violent than in case of high speed. This is one of the apparently paradoxical facts that a careful study of the forces involved will reveal. We shall incidentally come across the proof later. For the present let us consider the case of an engine 18″×38″ making 90 R. P. M. in the same way as we did the other. By the same reasoning we shall find that, if we assume one-half of the total pressure to be neutralized, an unbalanced pressure of 4½ tons will come on the piston in about $\frac{1}{20}$ second. Really, however, it would be quicker than this, for admission is much quicker in the case of a releasing gear. Probably $\frac{1}{40}$ second would be nearer the truth.

The two cases given above are not imaginary or unusual cases. I have myself come across cases in abundance where there was undoubted evidence of as great, and greater shocks, and I am sure every engineer of experience and observation can mentally supply numberless cases of the same kind. It really seems, sometimes, as if engines had been built without any conception whatever of the capability they possess in themselves for self-destruction. If anything, the shocks in the above examples are lighter than they are in the great majority of steam engines running to-day.

We have taken no particular account, so far, of any pressure acting on the piston, except that urging it forward. We did assume, however, that part of the pressure at the beginning of the stroke was neutralized or anticipated. The fact is, there is in all engines a counter pressure greater toward the end of the stroke, which is made up as follows: 1. During the whole stroke there is a back pressure of from one pound per square inch, or less, in carefully designed stationary engines, to sometimes nine pounds in locomotive practice. It probably averages about two pounds. 2. During the latter part of the stroke the steam is confined in the cylinder ahead of the piston by the closing of the exhaust, and is compressed, by the advancing piston, to an amount varying from perhaps ten pounds per square inch to two-thirds or sometimes three-fourths steam chest pressure at the end of the stroke. 3. In almost all engines the steam valve is given *lead;* t at is, the port begins to open before the piston has fully arrived at its "turning point." The amount of lead varies usually according to the fancy of the engineer. Some favor lead in large amount, and others object to it, on the ground that, since the crank is horizontal at the end of the stroke, all effort exerted parallel to its length is lost, and hence that it is better to have the pressure on the pin as light as possible while on or near the dead center.

In the writer's opinion the question that should be considered in determining to what extent lead is to be given, is how it affects the running of the engine. Moderate lead is probably of some advantage economically, as it helps out initial pressure, but it must be noted that, with the rapidly rising boiler pressures of the present day, this is of less importance than formerly. It will be readily seen that the admission of steam at 90 pounds pressure, to a cylinder where steam is compressed to 60 pounds, will be simply an equalization of pressure of 60 and 90 pounds, and the steam admitted will act with the compressed steam in opposition to the piston motion, and tend to shift the pressure from one side of the journals to the other. This, as will be seen, is only one side of the story—the steam side—but it is very important that it be clearly understood.

We have now outlined the action of the steam forces, but they are studied to the best advantage by the indicator diagram, which, as is well known, is simply a record of pressures throughout the stroke. We will first consider a pair of diagrams taken from a single valve automatic at 85 pounds boiler pressure, and 205 R.P.M. This engine is of a make well known for its smooth, quiet running. The diagrams are reduced from actual size as taken. Two points immediately arrest attention—the heavy compression and the presence of *negative lead*. By negative lead we mean that the piston has begun its stroke before steam is admitted. The presence of this peculiarity is shown by the forward inclination of the admission line $a\ b$. It is often a great factor in smooth running, but is very rarely used; so rarely that the writer can call to mind no other single valve automatic employing it. Let us now, by aid of the indicator diagram, trace the pressures. through one stroke. Referring to Fig. 1, the piston moving in the direction of the arrow, it will be seen that at b, the pressure urging the piston forward is 80 pounds per square inch. From the point of cut-off, near c, the pressure rapidly falls till it is about 25 pounds at d. Then a new factor enters in The exhaust at the left end of the cylinder closes, and the piston begins to meet an increasing resistance to its progress, caused by the compression of the imprisoned steam. This compression is shown by the line $e\ f$. It rises, neutralizing more and more of the pressure which is driving the piston forward till it reaches the point g. At this point the pressures *just balance each other*, and consequently there is no unbalanced steam pressure whatever on the piston.

The action for the remainder of the stroke is plain. In Fig. 2 the shaded portion represents unbalanced force, and it is seen that, after the piston leaves the point g, there is a constantly increasing unbalanced pressure resisting the piston motion, till finally the point of release at h being reached, the pressure tending to drive the piston ahead drops rapidly to about 1½ lbs., leaving an unbalanced pressure of about 75 pounds on the piston. Then admission occurring brings the pressure up to 80 pounds, when the return stroke begins, and events are repeated the same as in the previous stroke.

This diagram, as shown by the shaded portion of Fig. 2, may be termed the *real diagram of pressures for one stroke*, since it takes account of steam pressure on both ends

of the piston at once. It can easily be constructed for any engine from which a pair of indicator diagrams can be obtained, and its study will always be profitable. More examples of the same kind will be considered later.

A Midsummer Sermon.

BY PROF. JOHN E. SWEET.

SOME UNUSUAL CONSIDERATIONS IN REGARD TO WORKMANSHIP AND MATERIALS—WITH EXAMPLES IN POINT.

If the best workmanship is that which best serves the purpose for which it was intended, and that the best application of material which serves its purpose completely and lasts the longest, then the best work is not always that which is the best fitted, nor the strongest that which has the most material. While there is nothing new about these statements, they will stand oft repeating, and apt illustrations seldom fall out of place. Perfect as machine work can be done, still more perfect work in many ways can be done by hand. The object glass of a telescope depends for its final finish upon the handicraft of the skillful workman. A very good surface plate can be made by machinery, but a much better one by hand; and the final finish of the most accurate standard gauges is hand work. On the other hand, a better steam joint, metal to metal, can be made by machinery than is possible by hand—as is also true of many jobs done on a lathe or milling and other machines. A steam cylinder and piston fitted and finished like a standard plug and ring gauge, if of any considerable size, would never complete a trial trip, while a tolerably rough bored cylinder, if it be practically true, and a common turned piston, if not too closely fitted, usually work all right from the start. I think it has been the experience with engine builders generally that those engines have given the least trouble when the words *roughness* and *trueness* have been followed by an exclamation point.

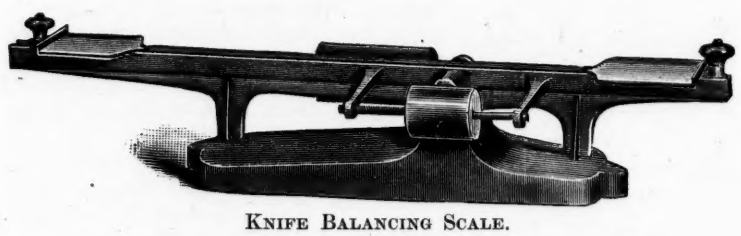
Absolute perfection in a journal and a box of hardened steel well oiled will do splendidly if not too closely fitted, but when that perfection cannot be obtained, I have seen very satisfactory results produced in troublesome cases by resorting to the apparently barbarous practice of draw-filing the journal endwise, or while in motion. In the whole category of causes for hot boxes, shafts out of round and out of line, or rough and crooked, bearings too small or boxes out of shape, are among those that may be classed as poor workmanship; while those that may be classed as too good or over-nice work are scarcely less numerous or less troublesome. Too closely fitted shoulders, oil holes and channels too aristocratic in their delicacy, and wearing surfaces so broad between the oil channels that the lubricant never reaches the whole surface, are among the common things that give trouble.

The "old-time" machinist, who had to fit up the strap end of his connecting-rod with chisel and file, had his brasses cast with the corners cut off octagon shape, partly to save brass and partly to save filing, and these things, good or bad, as they might have been fitted up, run well and long, and gave but little trouble; while the modern mechanical engineer, thinking to have a better job, insists upon having the brasses fitted perfectly throughout their entire surface, "so as to give a good bearing," with the result that they are quite too often a source of trouble from the beginning to the end. An exaggerated example will show the probable cause. Lay a piece of flat brass on a flat anvil or block and strike it in the center with a hammer; it will be found that the piece is bent with the ends up. In like manner the end of the rod and strap of a well-fitted stub end become anvils, and the pin, with its hardest bearing in the center of the box, becomes the hammer, and the two working away act on the brass as in the illustration, and bend in the end so they bind the pin. The modern grammarian would say that under the above condition the pin is liable to become heated; or, as Ben Johnson, Shakspere, and the old-time mechanic would say, "it gets hot." The remedy is to go back to the form used by the mechanic of the "chalk age" and cut away the corners of the brass, until the bearings on the strap and stub end are narrower than the bearing of the pin on the inside. This is a plain case where less metal and less work will make a better job.

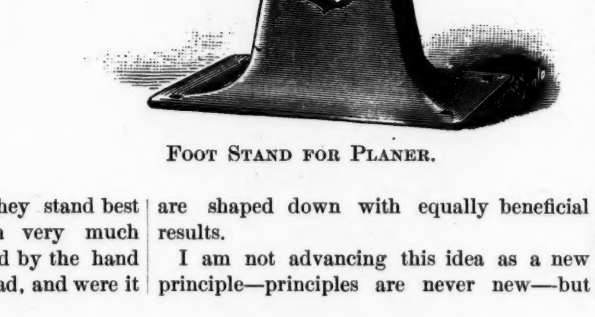
One of the common every-day cases of too much material in the wrong place is the ordinary hammer handle. They stand best against legitimate use when very much smaller between where grasped by the hand and up to near the hammer head, and were it frequency, our first move is to make it larger. "Put in more stock;" "get it big enough," are the expressions, rather than, "Would it not stand better if we made it smaller?" And here is where I want to put the principle in such a crude form that no one will forget it: *Make it smaller when it don't break.*

A new application of this idea has been made by Wm. A. Sweet, of this city, in the case of a steam hammer piston-rod. From close down to the hammer head up to where the rod draws up to the packing in the stuffing-box the rod is turned out smaller on the same plan that wood hammer handles are shaped down with equally beneficial results.

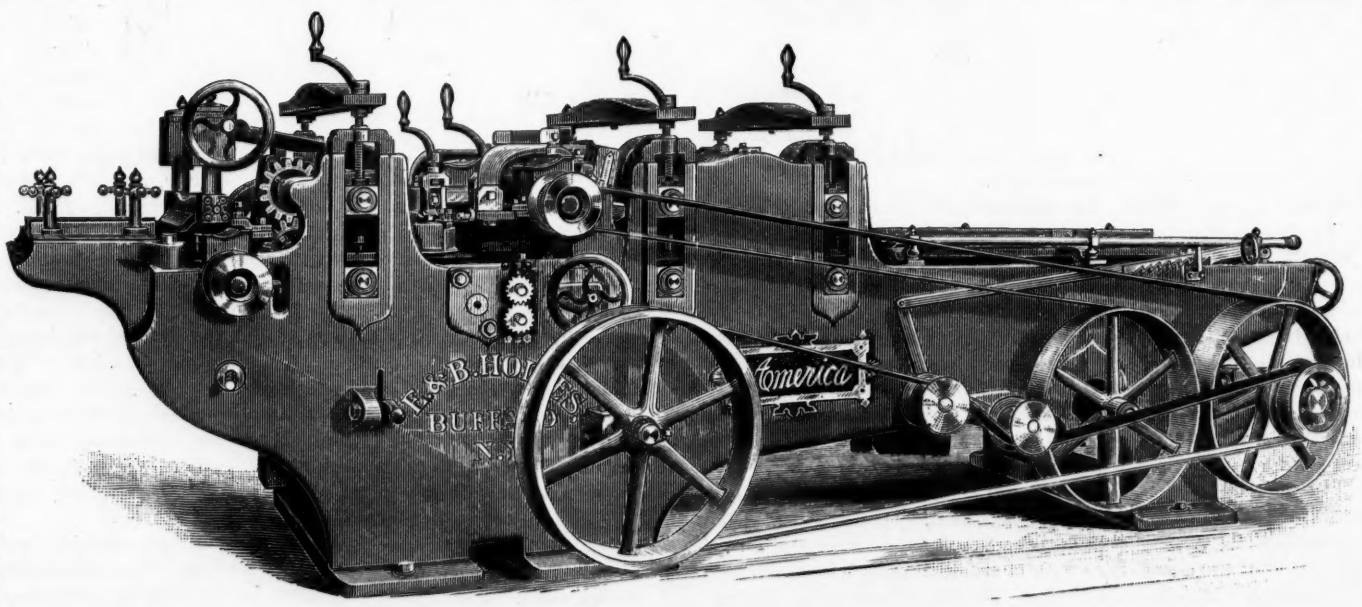
I am not advancing this idea as a new principle—principles are never new—but simply trying to put it in such form that it will be recognized as a principle, and be profited by.



KNIFE BALANCING SCALE.



FOOT STAND FOR PLANER.



PLANER AND MATCHER.

The Great Eastern is to be devoted to the cattle-carrying trade, so it is said. This is a big discount from the original intentions. This monster ship, it will be remembered, was to revolutionize ocean traffic, but it has proved itself to be a gigantic failure.

A Newly Designed Planer and Matcher.

With this we illustrate a new design of the "America" planer and matcher, together with a stand for use in connection with it, and balancing scales for balancing knives.

As will be perceived, the machine is quite heavy and massive, and has ample power and strength for the heaviest work. It is provided with an improved journal box, especially designed for convenience in taking up all lost motion resulting from wear, and to provide for ample lubrication and prevention of heating. Amongst the other features of this box is the very heavy cap put upon it; it being designed not only for mere strength to avoid breakage, but is heavy enough to absorb the vibration due to the blow of the knives. The pocket for holding grease extends along the entire length of the box, and is divided by a partition into two parts, one for suet or tallow, and the other for oil and waste.

An improved chip breaker is also provided on the matcher heads, made of hardened tool steel, held in place by two set screws, and can be adjusted to run as close to the matcher cutter as the nature of the work will permit. It can be readily taken out and ground into shape if it should become worn.

The manner of weighting the delivering rolls is claimed to overcome some very objectionable features, and to secure a uniformly distributed and sufficiently powerful feed to be always relied upon to carry the board out without the addition of any weight or any assistance.

The lower ends of the matcher spindles run on hardened copper in cups of oil, and both matcher spindles and the guide can be moved across the table with one crank—a matter of convenience, and enabling the bed to be worn equally across its whole surface. The chip breakers for top and bottom cylinders have an adjustment to and from the knives, thus permitting rabbeting, moulding, or other bits to project beyond the ordinary knives.

The cylinder heads are solid steel forgings, and the small pinions are of steel, as are also the roll-shafts, countershafts, cross-bars, screws and studs.

The tool stand shown is intended for use in connection with this or other machines, and is a great convenience for the operator. It is bolted to the floor as close to the machine as possible, and has a revolving plate to carry matcher-heads, oil cans, wrenches, etc. In the box above can be kept files, lace leather, belt studs, and tools of all descriptions that are usually made use of about such machinery.

The small cut represents improved knife balancing scales, for accurately balancing the knives. By the use of these scales not only the same total weight of the two knives can be secured, but the corresponding ends of each knife can be made the same weight, so that the cylinder shall be in perfect running as well as standing balance—a condition necessary to secure steady running, as everyone having had experience with such machinery knows. Two balancing weights are provided on the scales, the larger one being moved along until they are nearly balanced, and then the small weight (which moves on a screw) used to more perfectly secure the adjustment needed.

This provides for the fine adjustment essential to quick running machinery of this kind, which is essential to successful operation.

The makers are E. & B. Holmes, Buffalo, N. Y.

Making Patterns for Chain Wheels.

By F. W. Barrows.

Link belts are becoming so common nowadays that it is well for every pattern maker to know something about them, in order that he may be prepared to some extent when called upon for an effort in this direction.

Link or chain belting may not run quite so smooothly as leather belting, but there is no slipping, and for this reason they are specially adapted to short spaces, where gearing is not practicable and where leather belts are liable to slip if the speed is slow. The motion produced is similar to that by gearing. If the diameter of wheels is proportioned to the length of the links or pitch, then the motion will be smooth and the speed regular. The more teeth the smoother the motion, and *vice versa*.

Fig. 89 is a very common form of a chain wheel, and is made for an ordinary link chain forged from round iron. A wheel for this chain may be made in several ways as regards the position and shape of the teeth or lugs which give the chain a hold upon the wheel. Some forms are made very cheaply, both as regards pattern work and cost of moulding; others, being more complete, will cost more, but to offset this they will wear longer and also tend to prolong the life of the belt by presenting more wearing surface. The form shown in 89 is the most complete, and is also the most expensive, as regards pattern work. A portion of the rim is shown in section at *a*; *b* is a cross-section of same wheel and *c* is the chain used.

Taking all things into consideration, the best way to make these wheels is to form the groove on rim by a core. You may make the core in sections, but usually it is best to make a whole box unless it is a very large wheel.

This box may be turned in the lathe to the shape shown at *d*, Fig. 90; the distance from *e* to *f* equals one-half the diameter of iron used in making the chain. If you make a whole box it should be parted on the line *g h*.

The advantages of a whole box over a segment box are greater accuracy, fewer poor castings, and less work for the core maker and moulder. It is also better for the pattern maker, as he is less liable to make a mistake in the pitch of the wheel. The cores will always fit the moulds, while segment cores are very frequently a little too long or too short; this of course destroys the accuracy of the spacing.

Perhaps you may think that if the segment cores are made the right length, they will always fit the mould. So they would, but after the box is made just the right length, which is not easily done, and in calculating for which, you must be acquainted with the core maker and also the moulder; and in a great many cases where you know the core maker or moulder you will also know that the cores or moulds get better as the last pay day gets farther away. After all this we shall still have to take the chances of baking. All joking aside, however, we will allow, as perfection is something rarely attained, that it is easier to get a good job from a whole box. Again, if the core is made in halves, they are a bad thing to paste together accurately, and as for the extra work in making the whole box, you will find that the moulder will save the cost of that in making a very few moulds.

I have shown the core-box in section in Fig. 90. It has one side of the print left open all round. The core is rammed up through this opening and struck off level, then by lifting off the part marked *a* the core may be turned out on a plate and dried. The outside edge of print is made with plenty of draft, to faciliate turning the core out of core-box and to make it easier to place the core central in the mould. After our box is turned to the shape shown at *d*, Fig. 90, the next thing is to space it up. The most common fault with all chain and sprocket wheels is in the spacing—the length of the spaces being different from the length of the links. I will try to explain how this may be avoided to a great extent. Measure off a portion of the chain eighteen or twenty inches in length, being very careful to get exactly full links, say 10 links are found to be exactly twenty inches long, which makes each one two inches. In this way we reduce any error in measuring the length of a single link into as many parts as there are links in the space measured, on the principle that you can measure a single space with about the same degree of accuracy each time. It makes no difference what the length of the space may be, provided it is less than the length of the scale or rule used to measure with. This would ordinarily bring the space within two feet, the length of an ordinary rule. If, then, you could measure a single link within .01 of an inch you could also measure ten links within .01 of an inch, then by dividing this space into ten equal parts we have reduced the error in the length of a single link to .001 of an inch. We should of course measure the chain with a standard rule, and then take the same space from a shrink rule before dividing in single links.

The diameter and spacing of this wheel need not be so absolute as in making gear wheels; still the teeth in a single wheel should be all alike, in order that the motion produced by it may be regular,

To lay out the box we will make two templets, as shown in Figs. 91 and 92. These are made with a gauge piece that is placed against the part of the box that corresponds with the largest circumference of wheel. We will use the one marked 91 first, then with a templet like 91 *a* we will work out the spaces laid off by 91, which, by the way will be only every other space. After these are finished lay off the alternate links by templet 92, using a second templet like 92 *a* to gauge the depth of this last cut. This completes the core-box ready for varnish. If there are to be many cores made from this box it will be best to make it of iron, which may be made from either a wood or plaster of paris pattern. In case an iron box is wanted it will be possible to make it from a pattern of only one-half, or one side of the rim, by making the upper part of box first then adding the bottom and outside to pattern before making the second casting.

The pattern should have the rim glued up in segments, with the arm cut in, as explained in my articles on "Cable Pulleys," American Machinist, Oct. 9, 23, 1886.

A cheap wheel of this kind may be made by turning the core-box out to the size and shape of the chain; by this I mean of such size and shape that the chain will lay in the groove. Then to give the chain a hold on the wheel at every second or fourth link of the chain, two little pieces *a' a'*, Fig. 89, are fastened in the box, one each side. These pieces must be of such size and shape that they will go between the links of the chain as it lays in the wheels. This box is much easier to make, and it costs less, but the wheel does not wear as long, neither does it give the firm hold which the other form affords.

[The pieces marked *a' a'*, referred to in the description of the last form of wheel, using the chain *c*, Fig. 89, are also a part of the first wheel, as will be seen by studying both *a* and *b*].

There are other ways of making these wheels, but, as the two ways I have explained are the extremes, one being the most complete while the other has probably the least work it is possible to get along with, all other ways come between these two, being more or less complete copies of Fig. 89, and need not, therefore, have a special description.

Another form of chain, the construction of which is shown very plainly by the two views at *c c*, Fig. 93, and the links, which may be either punched from sheet metal or cast ready to rivet together. This is a cheap chain, for the pieces are all alike and easily put together.

The pattern for the wheel is also a simple thing to make. The rim should be laid up in segments similar to rim in Fig. 89. This rim has three rows of teeth on its circumference—the two outside rows being placed so that the teeth in one row come opposite the ones in the other outside row, while the middle row has the teeth opposite the spaces in outside rows. The middle row must be made by cores, and in turning up the pattern we make allowances for this by leaving that portion of the rim which is covered by this row of teeth wider than the two sides—this width to be such that the cores which will be described farther on will not topple over into the mould and cause the moulder to break all of his New Year's resolutions.

The edge of the rim will thus be divided into three equal portions—the diameter of the two outside parts being the same, while the center has a radius greater than either side by an amount equal to a little more than the depth of the teeth.

We should put a line on each side of the rim, to mark the bottom of teeth. The outside rows may then be laid out by a pair of dividers, and worked down to central part; this part should then be laid off and cut through, leaving prints, as shown by dotted lines *a d*, Fig. 93. Perhaps a more substantial way of making the prints for the center row of teeth will be to turn the rim square across and put on the core prints, each one by itself. In this way each single print is formed of one piece of wood, which might not be the case if they were cut out of the rim.

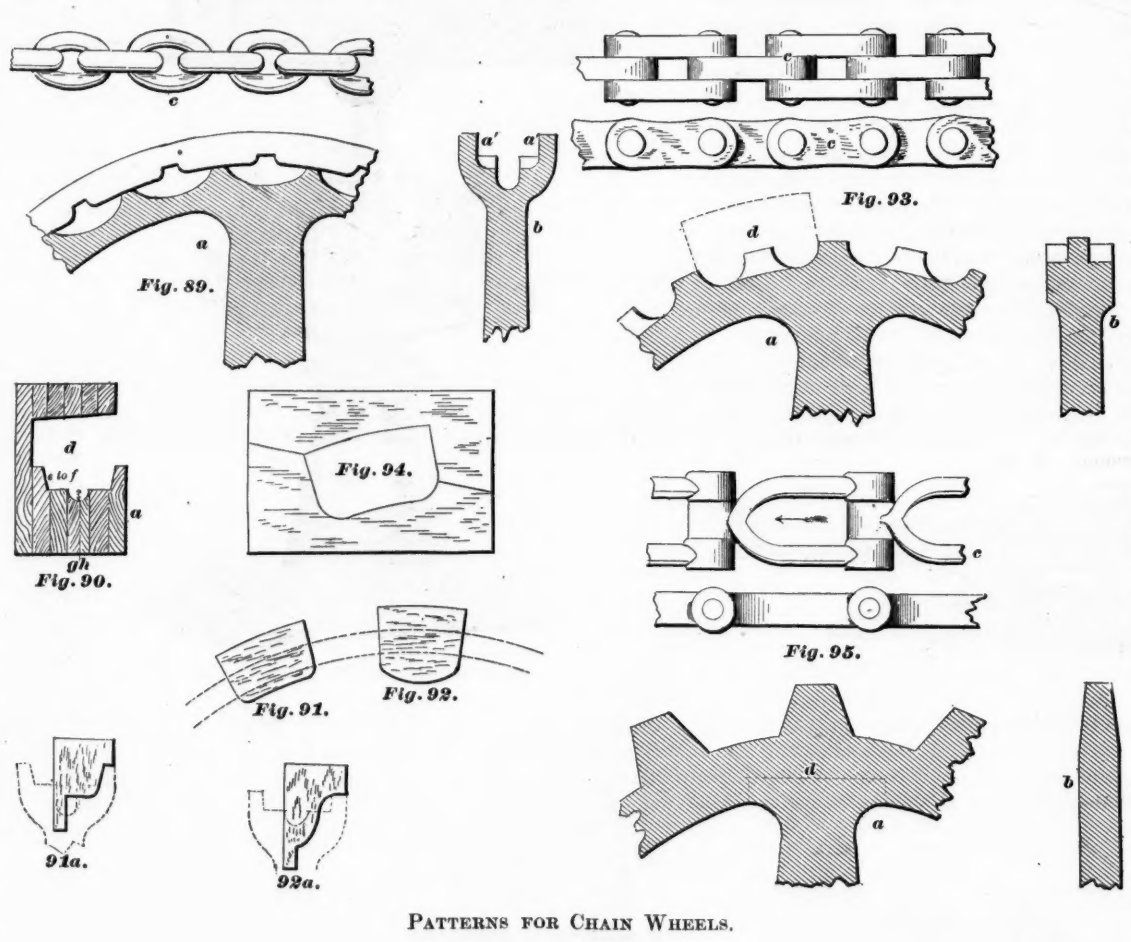
The core-box is shown at Fig. 94, and should be fitted very nicely to the print, in order to have the cores stand in just the right places.

This kind of a wheel may also be made in a cheaper form by leaving off all but the center row of teeth; keeping the rim of the same thickness as the chain, to give it a good support, and also to keep it from becoming jammed between the teeth.

There are several styles of sprocket wheels made with a single row of teeth, one of the plainest of which is shown in Fig. 95, *a* being a section of the rim, showing projection of teeth, *b* a cross-section of the same, and *c* the chain used. The chain is cast, each link by itself, and then riveted together.

While the chain and wheel shown in Fig. 89, and also the one in Fig. 93, will work equally well in either direction, this one (Fig. 94) is intended to move in one direction only, as shown by the arrow.

In this wheel, as the arms are as thick as the rim, we will let them in part way through the rim, as shown by dotted lines at *d*, Fig. 95, and secure them by nails. The rim should be laid up in not less than three courses of segments, and the teeth had better be put on separately, as if we make them a part of the rim we may have bad work when we come to laying and working them out, whereas if we put them on each one by itself, we shall have each tooth made of a single piece of wood.



Patterns for Chain Wheels.

A Draftsman's Kinks.

By C. L. Redfield.

Every art has its kinks and wrinkles which shorten and cheapen the processes, and which are part of the stock in trade of its workers. Too often, for the general welfare, these short and rapid methods are not given to the public, but live and die with the individual who originated them. This is specially true of draftsmen, who, not having any organization, do not seem to have any method of intercommunication, except through the columns of the American Machinist, and a very limited number of other journals. It is to rescue a few of these from oblivion that this article is written. Of the peculiar methods given here, some are original, others are adaptations from something else, while still others are pure inheritance, and are given because they do not seem to be generally known.

A common hex nut or bolt head is an item of multitudinous recurrence and tormenting tediousness to the average draftsman. To be able to make these rapidly, artistically and approximately accurate is not only balm to the perturbed spirit of the designer, but a matter of dollars and cents to the proprietor. A plan view of one of these nuts is shown in Fig. 1 (page 5), and the mode of drawing the side elevation in Fig. 2. The standard of distance across the flat *A*, Fig. 1, is $1\frac{1}{2}$ times the diameter of the bolt, plus $\frac{1}{4}$," and the height *C*, Fig. 2, is equal to the bolt diameter. The distance across the

corners B is a variable quantity, but is practically twice the bolt diameter for all sizes from $\frac{1}{2}''$ to $1\frac{1}{2}''$. It is just twice for $\frac{5}{8}''$ and $\frac{3}{4}''$ bolts, which are the commonest sizes, while for $1\frac{1}{4}''$ bolts the distance is $2\frac{1}{4}''$ instead of $3''$.

To draw the bolt head or nut shown in Fig. 2, take a radius equal to the diameter of the bolt, and from the center m strike the arc $o\ n\ s$. This gives at once the height, the extreme width and the arc showing the chamfer. The lines q and r, representing the corners, are midway between m and o and m and s. In reality their distance apart is equal to the diameter of the bolt, and they are but extensions of the lines representing it. It will thus be seen that the whole nut, except the outside chamfer curves, is determined by a single stroke of the compasses. Even these outside curves are in a measure determined because their centers will be found on this arc. To find them, take the same radius, and from the center p, equal to this distance from r, draw the arc, cutting the former one in t, which will be the center required. This is, of course, on the assumption that the extreme width is twice the bolt diameter. As a matter of fact, this is a little too large for large size nuts, but is near enough for a thing that is more for show than anything. If any one wants these upright lines nearer than this they can guess at it, but their guess is likely to be as far away as the construction, as it is quite common to make nuts larger than the standard, and almost identical with this construction. The arcs within the two outside faces are, of course, omitted in the inking process. They are given here to show the construction.

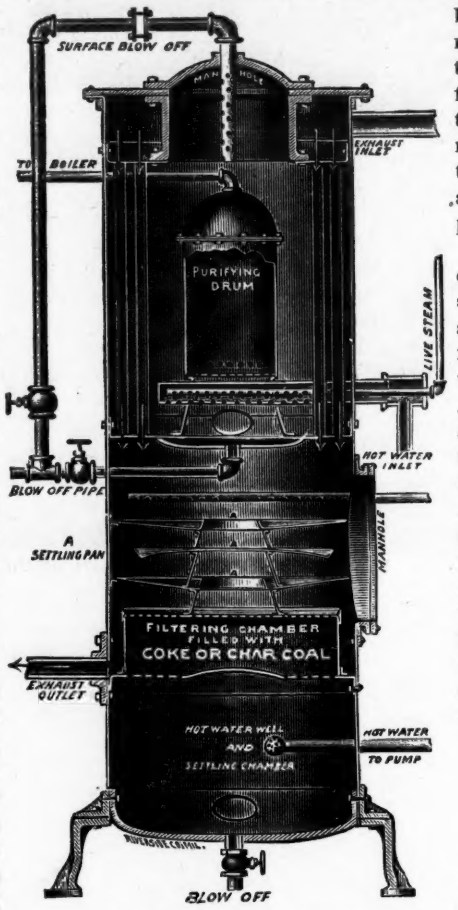
An ellipse drawn with circular arcs has been designated as an abomination, yet nine out of ten of all that the draftsman ever has to draw can be made sufficiently accurate this way, if the proper arcs are chosen. The following method, Fig. 3, is easy, rapid, and the best the writer has ever seen. Through a center O draw the axes $A\ B$ and $C\ D$, and with a radius equal one-half the major axis draw the circle $A\ C\ B\ D$; also lay off the minor axis $c\ d$. From the extremity of the major axis to that of the minor axis, draw the line $A\ c$, and from the center c, with a radius $c\ C$, draw the arc cutting $A\ c$ in c'. Bisect the line $A\ c'$ at right angles by the line $E\ F$, and where it cuts the axes in e and f will be the centers for the arcs. Having the centers e and f, the centers e' and f' are readily found. A peculiarity of this line $E\ F$ is that it is tangent to the small circle H drawn with a diameter $C\ c$ and tangent to the axes $A\ B$ and $C\ D$.

This leads to a somewhat simpler and quicker method of finding the centers e and f, which is shown in Fig. 4. Lay off the two axes as before, and draw the circle H with a diameter equal to $C\ c$, as shown. Then lay down the triangle S as if to draw the line $A\ c$, but without drawing it, lay the triangle T against S, as shown, with its edge tangent to the circle H, when the centers e and f may be marked without the aid of any construction lines.

Let us suppose that we have two pieces of shafting, any definite length, one piece $1\frac{15}{16}''$ diameter, and the other $2\frac{7}{16}''$ diameter; required the diameter of another piece of shafting, same length, which shall have a weight (or tensile or compressive strength) equal to the combined weight of the first two pieces. How many persons, draftsmen or others, are able to give this answer in one-half a minute, without the use of any tables? It is, nevertheless, the simplest kind of a problem. The whole question is simmered down to finding a diameter which has an area equal to the combined areas due to the diameters $1\frac{15}{16}''$ and $2\frac{7}{16}''$. We know that areas are to each other as the squares of their diameters, but the squaring of such numbers as $1\frac{15}{16}$ and $2\frac{7}{16}$ makes the ordinary draftsman inexpressibly weary. The graphic solution is shown in Fig. 5. Draw the lines $A\ B$ and $A\ C$ at right angles, and lay off on them the distances $1\frac{15}{16}$ and $2\frac{7}{16}$ at C and B respectively, then will the distance between these points be the required diameter.

It is not likely that the draftsman will have any such problem as this to solve, but by stowing away in the corner of his mind the application of the principle involved, his business will certainly be slight if he does not some time find it convenient in the solution of some analogous problem, such as finding how large a pipe is required to carry the discharge of two other pipes. It is not necessary to have paper and pencil to work this solution, as the square corner of a board and a two-foot rule will answer every purpose.

A draftsman may be fond of mathematical calculation, but he is apt to take hold of square root with about as much enthusiasm as a child takes bitter medicine. Square root may be extracted easily and quickly by the graphic method shown in Fig. 6. Lay off $A\ B$ with as many units in its length as there are in the number whose root is to be extracted, and with this as a diameter, draw the semi-circumference $A\ C\ B$. At a distance I equal to one unit from A draw the perpendicular $D\ C$, then will the number of units in the cord $A\ C$ be the square root of the number in the line $A\ B$. This plan is specially convenient in extracting the square root of mixed numbers such as $6\frac{5}{8}$ or $13\frac{1}{4}$. The demonstration that $A\ B = A\ C^2$ will doubtless be interesting work for a few minutes to more than one person.



COMBINATION FEED-WATER HEATER.

Combination Feed-Water Heater.

The illustration shown herewith is that of a feed-water heater in the construction of which the object has been to combine the features of an exhaust and a live-steam heater. The interior of the heater is divided, horizontally, into two parts, one of which is the exhaust heater and the other the live-steam heater.

The cold water enters the heater at the right by the pipe below the one designated "hot water inlet." This pipe is perforated inside the heater, and allows the water to fall in the form of spray into the upper one of the pans $A\ A$, from whence it goes to the filtering chamber, in which is placed filtering material, such as coke or charcoal. From this filter it descends to the settling chamber below.

During the passage of the water over the pans and through the filter it is exposed to the action of the exhaust steam, which enters at the top, as shown, and passes down through the flues, as indicated by the arrows.

The water, after being heated as far as possible by exhaust steam, is drawn out by the pump and forced in at the point designated "hot water inlet," where it meets live steam from the boiler, which is introduced in the manner indicated by the cut. It then passes through the "purifying drum" to the boiler.

Means of blowing off either from the surface or from the bottom of the live-steam heater are provided, and also from the bottom of the exhaust heater, as shown.

Man-hole and hand-hole plates are provided, as shown, by which access to the interior is easily had for cleaning when it becomes necessary. The water in passing through the exhaust heater takes from the exhaust steam all the heat to be obtained in that way, after which it is exposed to full boiler pressure and corresponding heat before going to the boiler, which results in the deposit of scale and impurities in the heater, which would not be made to deposit by the heat and pressure of exhaust steam alone, thus keeping the boiler clean.

This heater is made by the Adrian Brick and Tile Machine Co., Adrian, Mich.

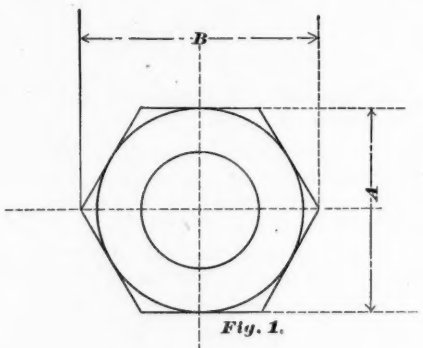


Fig. 1.

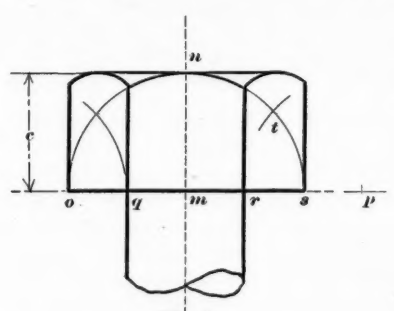


Fig. 2.

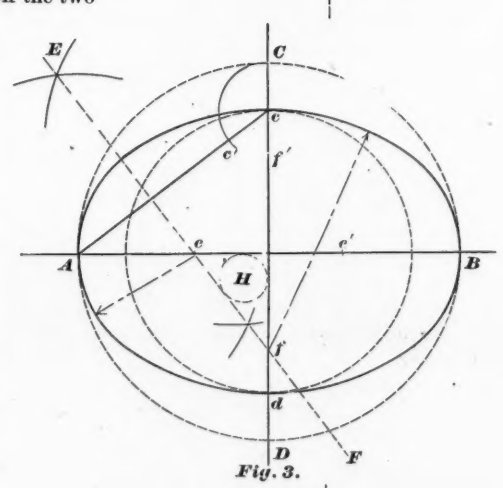


Fig. 3.

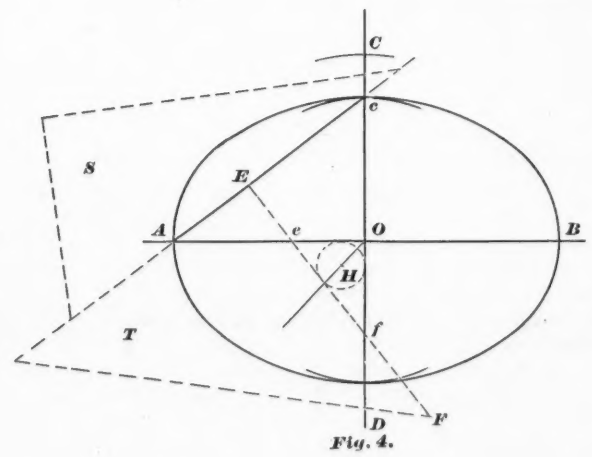


Fig. 4.

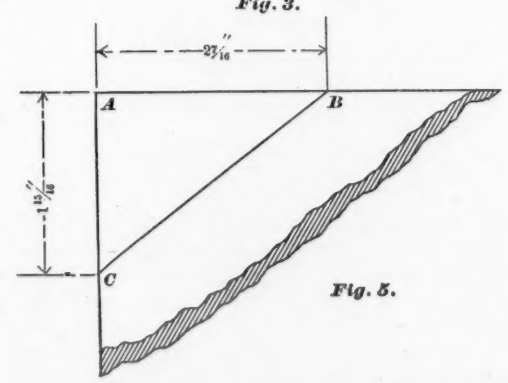


Fig. 5.

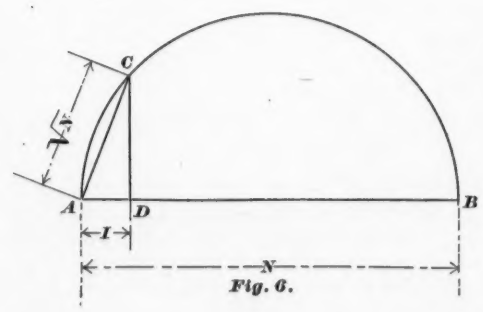


Fig. 6.

A DRAFTSMAN'S KINKS.—SEE PAGE 4.

LETTERS FROM PRACTICAL MEN.

Two Ways of Piping Boilers.

Editor American Machinist:

As "Jesse Camric" once said, in an article published by you, "Writing for a paper must be a business to be learned before a man can make a success of it." But, as I also have observed that we care more for a man's ideas, provided they are good ones, than we do for the way he expresses them, I shall take the liberty to make a few remarks, suggested by Mr. Williams' article in your June 30th issue.

What he says about a man who knows how to cut a thread on a piece of pipe thinking that he "knows it all," is nowhere more forcibly illustrated than in the Pennsylvania oil regions. There are hundreds of men there, who, having run a few rods or miles of oil pipe, are henceforth and forevermore "practical pipers," and what they don't know about the business, in all its branches, isn't worth knowing.

One of them, who applied for a job, told of putting in a "complete steam plant"; setting boiler and engine, piping the whole place, and starting everything up.

Now, as I had seen the aforesaid "plant," which consisted of a portable engine and boiler, engine mounted on boiler, and as there was no piping to be done except connect exhaust, and also as the engine did nothing but run one well, I did not consider the job much of a criterion to go by, so did not engage the man.

Another one, who was "an engineer, and a good one," asked one day what the pump on one of our small engines was used for. Questioning brought to light the fact that he referred to the steam-chest and valve stem.

Some of the engineers at the "oil farms," as the small fields are called, would have a "soft snap," were they not obliged to look after the whole place, one man frequently attending to engine and boiler, besides watching a dozen wells. They run night and day, and, so far as the steam is concerned, there is not much trouble. As a general thing gas is used for fuel, and after gauging the water and gas supply they can leave the boiler for days at a time.

Not a safe thing, you will say, but it is done right along. One man told me that he had left his engine for three days in succession. "But," said I, hoping to trip him up, "how do you oil your engine?" "Oh, I just fill the cups and leave her," said he, and judging from the manner in which the engine,

which was set on two sticks of timber laid on the ground, jumped and pounded, I was forced to believe him.

Well, the subject that Mr. W. suggested was about piping boilers, and I should like to show how a pair of them *can* be piped.

The two referred to are set in the basement of a building on the harbor front, and were put in by an experienced engineer.

Fig. 1 shows them as found, and Fig. 2 after making changes. In the sketch,

B B are the boilers ;
E, pipe to engine ;
H, pipe to circulations ;
C, Fig. 1, cross valve ;
O, valves ;
A, angle valves ;
I, inspirator ;
b, steam flue cleaner ;
g, steam gauges ;
S, safety valves ;
D, drum.

In making changes an angle valve was put on each boiler at *A*, and a pipe carried over front of boiler and connected with drum. As the ceiling came to within a few inches of boiler tops the drum had to be dropped below supply pipes, and as this left no chance for condensed steam to return to boilers, a drip was taken from its lower side and connected with the main return. This arrangement has, so far, worked perfectly, a check in drip pipe preventing any backing of water into drum.

The feed, which originally entered the boilers at the bottom, and is not shown, was introduced at the top, and a power pump put in, for use when the engine was running, giving a saving of nearly 300 pounds of coal a day.

The blow-off, which was taken from back head and carried over the top of boiler to connect with sewer pipe, a valve having been left at lowest point for running out water, which was let out on the floor and run into a drain, was taken from the bottom and connected directly with drain, blowing off below high water mark.

As will be seen, there is not so much to do in changing from one boiler to the other, as regards valves, and all but the two stop valves can be reached from boiler room, whereas before the engineer was obliged to crawl under the floor to get at them.

There was some objection made to putting on a drum, on account of there being more radiating surface, but by actual measurement there were just 25 feet less than with the old arrangement, and also nine less valves.

J. H. E.

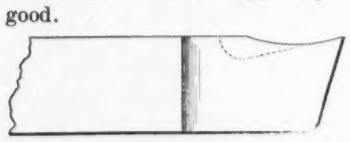
That Cutting Tool.

Editor American Machinist :

Frank H. Richards, in a late issue, uses strong language in writing about cutting tools, and I have noticed that those who use strong language are apt to be unduly prejudiced. In his sketch of an ideal cutting-off tool we find the steel taken away where the tool should be strongest. Is this good practice to teach the boys ?

Mr. Richards says : "The chip must roll up as it is cut, to be able to get out of the way," etc. If so, why not make the top of the tool a little larger curve than we expect the chip to be ?

If the chip rolls up 1½″ in diameter, I should say, very good.



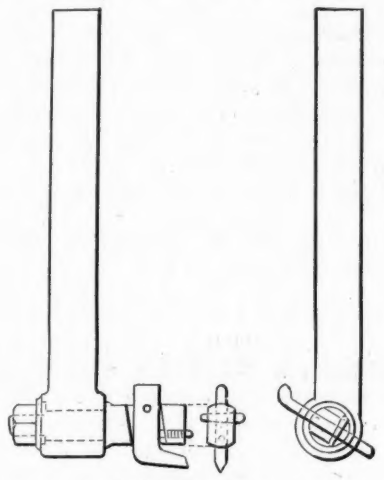
In the accompanying sketch, dotted lines show Mr. Richards' method, and, we think, the difference in "resistance" would have to be weighed with something finer than Troy weight. I would not always curve the top of a tool, but sometimes very soft stock can be cut off in one-half the time without danger of tearing the surface, by resorting to the "execrable circular groove."

Another Richards.

A Planer Bar.

Editor American Machinist :

In the June 30 issue I notice an article on planer bars. I enclose a sketch of a bar that I think has some advantage over the one you illustrate. The bar is 3″ square, enlarged at one end to 4″, turned to one side, as shown in sketch, and a 2″ hole bored through. The



A Planer Bar.

tool post is made to fit both sides of the bar, so it could be used either right or left hand

The tool was carefully fitted sideways; a tapered pin kept it in its place and a spring held it back ready for cutting.

We had another tool post 16″ outside the bar, that we used on jobs that could not pass between the posts.

I used this bar for all planing where the distance was 12″ or over from the head, and used the same tools that were used in a small slotter bar.

If any readers of the American Machinist have seen or used a better bar I would like to see a sketch of it. Geo. J. Mashek.

Mariette, Wis.

[The bar which we illustrated in our issue of June 30 was for under planing only ; while the one shown by Mr. Mashek is evidently for a different purpose, viz., reaching down into places inaccessible by ordinary tools ; thongh of course it could be used for under planing to a certain extent, as indicated in the figure.]

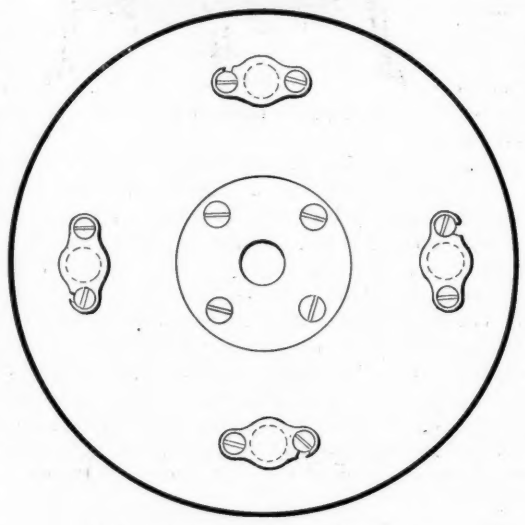
A Method of Balancing Polishing Wheels.

Polishing and buffing wheels, made of wood and covered with leather, to which emery is fastened with glue, are very extensively used in manufacturing, and are justly quite popular, being cheap, light, and comparatively safe at very high speeds.

One of the greatest drawbacks in their use is the inconvenience attending their accurate balancing. As everyone having experience with them knows, they must be frequently re-balanced, usually every time a fresh coat of emery is put onto them, and the usual practice is to drive nails into the sides of the wheels, some or all of which must be pulled out the next time the balancing process is repeated, so that after a short time, especially if the balancing be done by the not extraordinarily skilled hands usually entrusted with such work, the wheels look as though they had been used as shotgun targets at short range, being completely riddled, so that they can no longer be depended upon to hold nails securely, nor to hold themselves together, and are therefore worthless.

A much neater, more workmanlike, better, and in the end more economical plan has been devised by Mr. John J. Grant, and put into use at the works of the American Sewing Machine Co. He bores four holes, about an inch in diameter, almost through the wheels. The holes are equidistant from each other, and situated about as shown in the sketch. They are covered by thin pieces of metal, held in place by two screws, and arranged to be swung off to one side, as shown. The usual arbor, rolling upon level straight edges, is used for balancing, and in the holes are placed small strips of lead, about equal in length to the depth of the holes. These strips are so disposed as to balance the wheel perfectly, and, when running, are kept firmly in place by centrifugal force. After the proper strips are in place, the sheet metal covers are swung into position over the holes and the screws tightened.

A wheel made in this way may be painted, to protect it from the action of moisture, and



Balancing Polishing Wheels.

looks like a thing designed and made for a certain definite purpose, instead of like a mere makeshift, and is also more safe. Care should be taken in putting on the sheet-metal caps to arrange to have the slots opening outwards, as the drawing shows them ; if otherwise, and the screw should become loose, the cap would swing out and the operator would probably lose some fingers.]

It is an excellent thing in newspaper work for the writer to have some conception of the subject upon which he writes. The technical press is prone to criticise the attempts of reporters on the daily press to tackle technical subjects, and their criticisms usually have a funny point to them. When a writer essays to write about things he is not acquainted with, he, in the language of the small boy, is likely to get left. But what shall be said of the technical writer who gets beyond his depth ? He is likely to struggle as fruitlessly as the daily reporter who is ignorant in relation to that about which he writes.

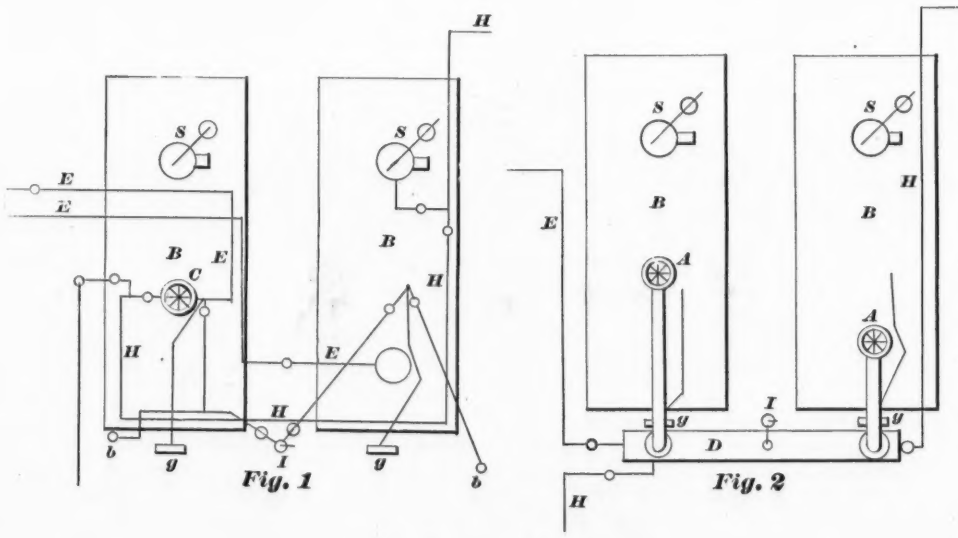
The foregoing is prompted by reading the efforts of a technical contemporary to "report" the proceedings of the recent Master Mechanics' Convention. In this report as accomplished an engineer as Mr. Lauder is credited with favoring the "expansion of smoke arches and straight stacks," and is in favor of using "extension smoke-stacks."

This is rich enough to be credited to some daily reporter, working on space, but alas ! it is from a technical journal.

Then we read of stacks "extended at the the base and pointed at the top," whatever the writer referred to may mean, and also of the advantages of the "midfeather tube," and so on.

When a writer for the technical press sets out to write on subjects strange to him, it would be a good thing, sometimes, to get the much despised daily reporter to overlook the terms he uses. He would generally make an improvement on them, or at least put them in such shape as to enable the reader to guess what was referred to.

There seems but little reason to doubt that a bridge will be built across the Hudson River, between New York and New Jersey, for the accommodation of all railroads having occasion to use it. The bridge is to consist of a single span, 140 feet above high water. The construction of such a bridge will be one of the greatest undertakings of the day.



Piping Boilers.—See Page 5.

Notes on the Expansion of Steam.

By Richard H. Buel.

EIGHTH PAPER.

The object of a steam-jacket should be to prevent the formation of moisture within the cylinder, by heating the cylinder sufficiently to prevent all internal condensation. When a jacket is properly designed and operated, all condensation of steam due to the work of expansion and to radiation and conduction is transferred from the cylinder to the jacket, and all water of condensation should be removed from the jacket as soon as formed, by a pump or an efficient automatic trap. Steam-jackets, designed and operated in the manner briefly outlined above, invariably produce considerable economy ; and it is by neglecting one or more of these essential points that many steam-jackets are a source of waste rather than economy, so that a number of experienced engineers do not regard steam-jackets as desirable. For instance, steam-jackets are sometimes so arranged that the steam admitted to the cylinder passes first through the jacket, where it is partially condensed. Such jackets are usually wasteful instead of economical, because they increase the condensing surface, and actually add moisture (instead of preventing its formation) to the steam admitted into the cylinder. In other cases the jackets are not drained efficiently, and are thus changed from heaters into condensers. The principles for designing and operating steam-jackets so as to produce the highest efficiency may be summarized as follows :

1. Jacket all condensing surfaces with live steam.

2. Do not admit any water into the jackets, and remove all water of condensation as soon as formed.

3. Return the water of condensation from the jackets to the boiler, using a return-trap or a force-pump.

4. Cover the external surfaces of the jacket with a good non-conductor.

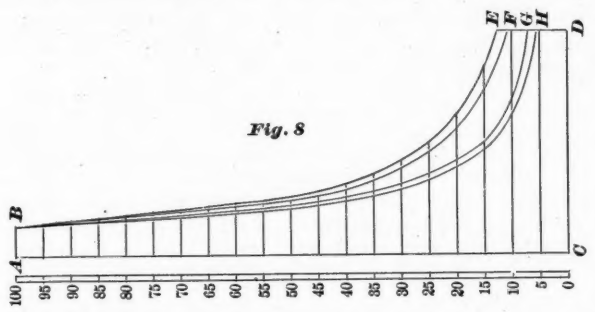
Steam-jackets satisfying the foregoing conditions will be effective heaters, and will produce considerable economy. To illustrate the advantage of high temperature in a steam-jacket, some experiments recently conducted in Europe may be briefly cited :

Test of a jacketed steam engine with high-pressure steam in jacket.

Item.	Pressure of steam in jacket lbs per sq. in. 176.	56.2
Duration of trial.....	6h. 18m.	7h. 11m.
Initial pressure, lbs. per sq. in.....	56.6	56.2
Indicated H.P.....	25.9	25.67
Pounds of water hourly per indicated H.P.....	19.6	23.5

When a steam-jacket acts so efficiently as to prevent the formation of moisture within the cylinder, the curve of expansion, instead of following Mariotte's law, where the pressure varies inversely as the volume, is a curve of dry saturated steam, in which the pressure varies approximately, inversely, as the 17th power of the 16th root of the volume. This curve falls slightly below the isothermal curve, so that the mean effective pressure of a steam engine with an effective steam-jacket is generally slightly less than it would be if the jacket were removed, the initial pressure and point of cut-off being identical in the two cases. A graphical illustration of this statement is given in Fig. 8, where it is supposed that steam at an absolute pressure of 100 pounds per square inch is expanded 8 times. In an unjacketed cylinder, an isothermal curve *B E* would be produced; while the curve for an engine with an efficient steam-jacket would be *B F*. Two other curves of expansion are shown in Fig. 8, which will be briefly explained, and will be considered more fully hereafter.

Fig. 8



EXPANSION OF STEAM, INITIAL PRESSURE 100 LBS. PER SQ. IN., CUT OFF AT 3″, IN A CYLINDER HAVING A STROKE OF 24″. NO CLEARANCE.

Distance from commencement of stroke—Inches.	Absolute pressure, pounds per sq. in. Isothermal curve. *B E*	Dry saturated steam. *B F*	Superheated steam below the temperature of gaseity. *B G*	Gaseous steam. *B H*
1	100	100	100	100
2	100	100	100	100
3	100	100	100	100
4	75	73.6	68.1	66.7
5	60	58.1	50.6	48.7
6	50	47.9	39.7	37.7
7	42.9	40.7	32.4	30.4
8	37.5	34.8	27.1	25.1
9	33.3	31.1	23.1	21.3
10	30	27.8	20.1	18.4
11	27.3	25.2	17.7	16.1
12	25	22.9	15.7	14.2
13	23.1	21.1	14.2	12.7
14	21.4	19.3	12.8	11.4
15	20	18.1	11.7	10.4
16	18.8	16.9	10.7	9.5
17	17.6	15.7	9.9	8.7
18	16.7	14.9	9.2	8.1
19	15.8	14.1	8.5	7.5
20	15	13.3	8	6.9
21	14.3	12.7	7.5	6.5
22	13.6	12	7	6
23	13	11.4	6.6	5.7
24	12.5	11	6.3	5.4

B G represents the curve of expansion of superheated steam, when superheated below the temperature of gaseity.

B H is the curve of expansion of superheated steam when in a gaseous state. This latter curve is also called the adiabatic curve, or curve of no transmission of heat, of a perfect gas. The table which follows shows the pressures at various points of the expansion, and the values there given were used in laying out the curves of Fig. 8.

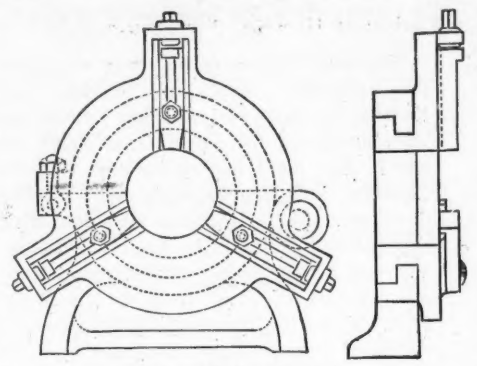
In determining the effect of a steam-jacket upon the economy at the various points of cut-off assumed in this discussion, the problem may be treated in two ways: The effect of the addition of a jacket to the engine as already designed may be calculated; or the dimensions of a jacketed engine to produce the required horse-power may be computed. Since the effect of adding an efficient steam-jacket is to reduce the effective pressure, the effective horse-power will also be diminished to some extent, if the first method of calculation is adopted. But the general formulas already published show the manner of proportioning an engine to develop any required horse-power when the mean effective pressure is determined; so that, whichever mode of calculation is chosen, all the necessary data for the other calculation will be given. It will abbreviate the discussion, without detracting from its clearness, to assume that all the changes to be made, commencing with the application of a steam-jacket, are to be effected with the engines whose proportions have already been determined.

The problem now presented is to calculate the theoretical effect of jacketing the steam engines whose dimensions are given in the table published in the AMERICAN MACHINIST of June 30, 1888, being careful to make no assumptions which do not accord fairly with good practice.

A New Center Rest.

The accompanying cut shows the construction of a lathe center, or steady rest, the invention of Henry B. Gould, 42 Prairie avenue, Providence, R. I.

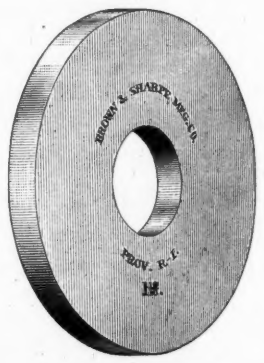
Every lathesman is familiar with the objectionable features of the ordinary rest, viz., the necessity for first turning a place on the work to which the rest jaws can be applied, which place must be turned as true, and must afterwards wear as true, as the finished work can be, because the truth of the work depends upon the truth of the part to which the rest jaws are applied at the time of finishing. It is also impossible to use the ordinary rest upon shapes other than round, without first applying a sleeve or collar centered and held in place by set screws.

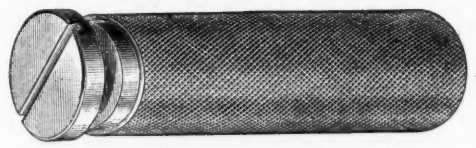


NEW CENTER REST.

It is the object of this rest to avoid these difficulties by providing a working bearing in the rest itself, in the manner shown by the cross-section. The jaws have their seats in the usual slotted recesses, which are made parts of a ring which is turned true, and has a bearing in the rest which is turned out to receive it, and of which it is a part. In this way the ring and jaws revolve with the work, the truth of which depends, of course, upon the centering of the ring, and the truth of its bearing in this rest, which is so large as to prevent serious wear during the progress of a job.

This provides for the work coming out true at the finish.





Standard Reference Disks.

To those of our readers who have had experience in the matter of the maintenance of standard sizes, it is unnecessary to speak of the advantages of having in the shop, and at all times conveniently at hand, some standard of sizes to which reference can be made, not only for the making of shop tools of uniform accuracy, but also for the detection and correction of errors in micrometers, and other measuring tools, caused by wear, accident or abuse. The advantages of such standards are well known, the principal bar to their use being their cost.

It is with the object of furnishing standards available for the uses indicated, and also to some extent for use as working or internal cylindrical gauges, and at a low cost, that the Standard Reference Disks illustrated herewith are being introduced by the Brown & Sharpe Mfg. Co., of Providence, R. I.

As the engraving shows, they are round washer-shaped pieces, made to be used either with or without handles. They are made of steel, hardened and ground accurately to size, the smallest being $\frac{1}{4}''$, and the largest 8″ in diameter. The sizes vary by sixteenths of an inch, 45 disks, with six handles, constituting a set. With the handles, they may be used as internal cylindrical gauges, but are designed, however, to serve principally as reference, not as working gauges. They are as accurately ground to size as the cylindrical gauges furnished by this company, but, of course, are not claimed to be equal to them in all respects, because the measuring surfaces are not so large, and the wear is correspondingly greater. They can be used also as standards, with which working gauges may be compared, and for setting calipers, grinding snap gauges, etc., answer every purpose, and having sufficient measuring surface to last for years.

They are furnished in sets of forty-five disks, with six handles (those on the $\frac{1}{4}''$ and $\frac{5}{16}''$ sizes being permanently attached), packed in a suitable box, or singly, as may be desired, by the makers, as above.

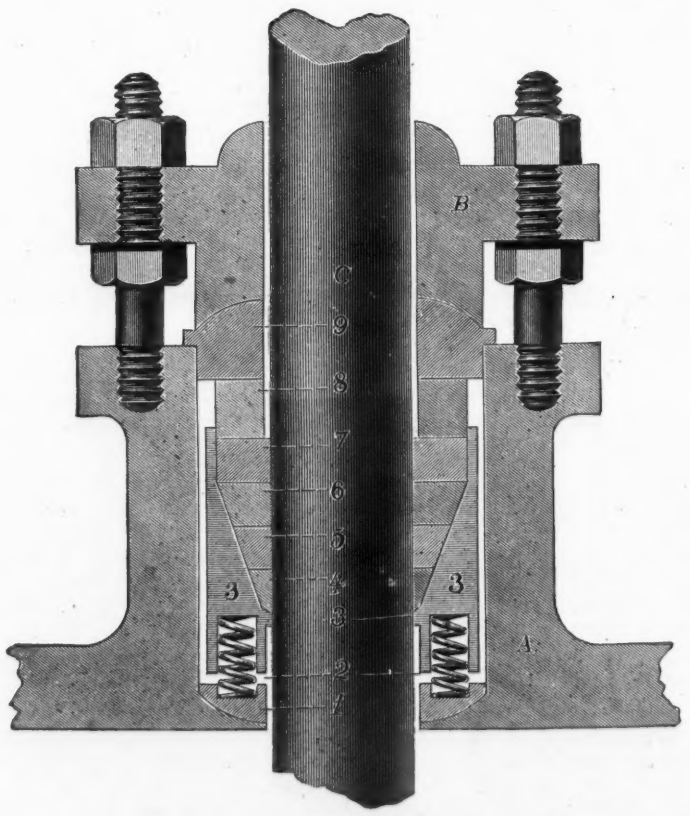
Brockett's Improved Metallic Packing.

The engraving shows the construction of this packing so clearly as to leave little necessity for description.

It differs from packing of somewhat similar construction, formerly in use, in having an arrangement of ball and socket joints, by means of which the packing automatically aligns itself with the stem or rod.

It will be observed that the packing is set against the rod by the pressure of steam, which pressure is relieved during exhaust, thus reducing the friction.

This packing is manufactured by W. E. Brockett, Berlin, Wis.



IMPROVED METALLIC PACKING.

A continuous automatic railway brake, worked by steam, has been invented by Mr. R. H. Orton, of 11 Queen Victoria street, London, where its action is demonstrated by means of a model one-quarter full size. Under each carriage is placed centrally a longitudinal brake-bar of steel, having mechanism attached to it by means of which the brakes can be simultaneously put on from either end of the train throughout its whole length. The driver does this by means of a steam cylinder and piston, and he can either instantly and simultaneously release them or keep them fully or partially on for any length of time. The brakes are operated by the guard by means of a store of force, consisting of a coiled spring, under compression, in a cylinder placed beneath the van. By means of a quick screw motion, controlled by bevel gearing in the van, he can apply and release the brakes with facility, but not so quickly as the driver can with the steam cylinder. The carriages are fitted with central buffers and are also coupled centrally. The automatic action of the brake was shown to be brought into play in the event of the couplings breaking. It is stated that in no case could any portion of the train become detached unless the brake-bar itself was broken as well as the couplings, and that if that took place the brakes would be locked full on.

This represents one of the attempts to improve automatic brakes, about which little is known at present, but it is a move in the right direction, from which something is likely to come.

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NEW YORK, JULY 28, 1888

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Locomotives for New South Wales.

The never-ending controversy regarding the comparative merits of American and English locomotives has again broken out with increased force. Some time since, we noted the discussion going on between Canadian and English engineers regarding the matter, the Canadians, as a result of their experience, upholding the American design. The seat of war is now transferred to that other colony of Great Britain's, which she kindly allows to have a share in the administration of its own affairs, Australia, or, more properly, New South Wales. It seems that the "Minister of Public Works" for New South Wales, after some experience on the roads there with both the English and American locomotives, came to the same conclusion arrived at in Canada, *i. e.*, that the American engines were better adapted to the service, and should be exclusively employed. This conclusion was based upon actual comparison of the engines upon the same system of roads, but with American engines built some ten years ago, since when, as every American interested in the subject knows, some decided advances have been made in the construction of locomotives in this country. This Minister of Public Works, being in Australia, could hardly be expected to do what is sometimes difficult for Americans to do themselves, *i. e.*, keep track of American improvements in locomotive construction; and when a number of new locomotives came to be required for the roads under his charge, he very naturally preferred those which had given the best satisfaction in actual use; and not knowing of the advancement made in the art of locomotive building in this country since they were built, very naturally concluded that they were still the best engines obtainable for the service demanded, and insisted that the proper thing to do was to have Australian builders duplicate them exactly, giving as his reasons, not only that they were the best, but that any departure from them in design would, by increasing the number of types of engines in use, increase the cost of maintenance—a fact which every railroad man will at once recognize as true, and not to be overlooked in the selection of additional engines for the equipment of a road, unless some decided compensating advantages are to be secured by the adoption of different designs. This New South Wales official, being so far removed from America, could hardly be expected to be fully posted regarding recent advances, and therefore, for the reason given above, opposed any change. But finally, for some reason, it was thought best to ask the American builders (the Baldwin Locomotive Works) what they would duplicate their former engines for? In their reply to the inquiry they said: "Since the Consolidation and American type locomotives to which you refer were built, the advancement in locomotive practice in this country has been so conspicuous that we feel we would not be doing justice to your Government nor to ourselves to furnish drawings for perpetuating those engines." They also mentioned the lines upon which improvement had been made, stating that greater economy of fuel had been secured as well as decreased wear due to slipping. *Engineering* thereupon says that "A more complete and trenchant condemnation of the original engines could scarcely, we think, have been framed"; calls it "a Nemesis" for the Minister of Public Works, and declares that such an *exposé* ought "to convince the head of the New South Wales Government of the necessity for at once making radical changes in the management of the railway department;" all of which strikes us as being somewhat amusing. There is no journal with which we are acquainted for whose opinions and statements we have more respect and confidence; but we cannot avoid the conviction that this attack upon the Australian official is due entirely to the fact that he was fair-minded enough to throw prejudice to the winds and commend for use upon the roads controlled by him, the locomotives which, in actual service, had given the best results. We cannot doubt that, had he recommended the duplication of the English engines, for the reasons given, and had afterwards received from the makers such "a complete and trenchant condemnation" of them, there would have been no attack upon him.

The fact that the Baldwin Locomotive Works stated that the engines built by them ten years ago had been superseded by better ones, in no wise affects that other fact, that the New South Wales official found the old American engines to be the best ones on the road, and it seems to us that when he recommended for duplication the best engines he had any knowledge of, he simply followed the dictates of common sense and the teachings of all railroad experience.

The particular kind of "complete and trenchant condemnation" alluded to is being indulged in very largely in this country, not only by locomotive builders, but by those engaged in almost every other branch of machine building, and the freedom with which they adopt new ideas, change their designs and throw away the old ones, "condemning" them by announcing that they have something better, is the chief reason that Canadian, New South Wales, and South American railway officials are discovering, and will probably continue to discover, that American locomotives are superior to any others.

In Bad Taste.

The "New York correspondent" of *Engineering* (London) in a recent article published in that journal upon "The City of Boston," while illustrating and describing many of the admirable features of that city, seems unable to rise above the petty and senseless jealousy of feeling and sentiment too much entertained by New Yorkers for the city and people of Boston, and as a preliminary to his article, proceeds to slur the city and its people in a manner wholly uncalled for, and in bad taste, especially considering that it is written presumably by an American to a foreign journal, the vast majority of whose readers will be entirely unable to make the proper allowances for it, which would be made by any American; since all Americans would at once perfectly understand the animus of it.

Further along in the same article he goes out of his way, and introduces something entirely foreign to his subject, apparently for the sole purpose of offering a wanton insult to a large class of American citizens, as uncalled for as it is senseless, and which we do not think would be published by any reputable journal in this country.

Every American of any intelligence whatever, no matter what his opinions may be as to the virtues of our Irish citizens, and the organization of the Knights of Labor, knows that to speak of them as though one included the other, and to apply to both indiscriminately the terms "turbulent bog-trotters," "lot of drunken, swaggering, singing cattle thieves" is an insulting misrepresentation, and we are surprised and regret very much that a journal of the very high standing and character possessed by *Engineering* should have made the mistake of allowing an American to smirch its columns with such stuff, so entirely foreign to engineering matters, and so utterly untruthful and uncalled for.

One of the outcomes of the engineer's strike on the C., B. & Q. road is the prosecution of some of the brotherhood members for attempts to use dynamite, soda, and emery for the purpose of disabling trains. And the effort is made, in some quarters, to fasten these attempts upon the officers of the brotherhood, and the brotherhood at large. We believe, and sincerely hope, this will fail. There are not a dozen men in the country that believe the brotherhood is responsible for attempted outrages on the C., B. & Q., and if it shall be found to be a fact that brotherhood men have been engaged in attempts to injure the rolling stock or the road, it will make no difference in public opinion. The brotherhood has for years been recognized as one of the most conservative of labor organizations, and, without reference to the wisdom of their strikes, they have always fought their battles without resort to incendiary measures. Unjustly condemning such an organization as the Brotherhood of Locomotive Engineers is likely, if it succeeds in injury to it, to pave the way for an organization that will adopt less conservative methods in its disputes.

We believe, as we have previously intimated, that the attempt to connect the brotherhood with the outrages on the C., B. & Q. will end in failure.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(346) J. M., Rock Bar, Idaho, asks: Please give me a rule for finding gears for cutting threads on the lathe. *A.*—You will find a comprehensive rule for this in Question and Answer No. 15, issue of Jan. 14, present volume.

(347) J. G. S., Claytonville, Ill., asks: Why is it that steel boilers will leak on first firing, and iron boilers will not? *A.*—Steel boilers, if properly constructed, are no more likely to leak on first firing than iron boilers.

(348) A. L., Scranton, Pa., writes: Please let me know how to set the taper on a lathe to chase threads on a taper tap. *A.*—You will find directions for setting the lathe in the answer to Question 196, issue of April 14, present volume. Set the center line of the tool at right angles to the center line of the tap.

(349) W. J., Rochester, N. Y., asks: How much power will be required to turn a 30-inch propeller wheel from 350 to 400 revolutions per minute; pitch 45 inches? *A.*—According to A. E. Seaton's formula it will require about 50 indicated horse-power to turn it at the rate of 400 revolutions per minute.

(350) E. F. M., Louisville, Ky., asks: Will a casting with chilled parts remain unchanged in going through the process of turning it to malleable iron; or will this process anneal or destroy the chilled parts of the casting? *A.*—Generally, chilled castings are not suitable for this process; in any case if the attempt is made the chilled parts of the castings will be destroyed.

(351) C. H. G., Hamilton, Ohio, asks: Please give me a receipt for varnish to preserve drawings. *A.*—Our practice is to dissolve white shellac in alcohol, both of the best quality. Only a small amount of white shellac in proportion to the amount of alcohol will be necessary; the varnish should have a consistency which will enable you to apply it easily with an ordinary flat varnish brush. Keep the varnish closed tightly when not in use.

(352) J. H. B., Kingston, Ont., writes: Can you give me a receipt for a pulp made from old papers, suitable for filling cracks in floors? It is, I believe, a sort of papier-maché, and if I remember right has flour paste with it. *A.*—We do not know of any receipt for a pulp for this particular purpose, but it seems to us that it can be made in the same manner as papier-maché, namely, a plastic material formed of cuttings of the paper, boiled in water, beaten to a paste in a mortar, and then mixed with a solution of gum-arabic size, to give tenacity. For your purpose we believe that flour paste can be used in place of gum-arabic.

(353) D. D. L., New York, sends a sketch of some pulleys and belts and asks some questions regarding the relative speed of the pulleys. We are not sure that we understand the drift of the question, but it seems to be somebody's opinion that the size of the shaft upon which these pulleys run has something to do with the speed of the pulley; which is a mistake. A wheel 4 feet in diameter will run at half the speed of one 2 feet diameter practically, without regard to size of shaft. For close calculations, however, or for high speeds, it is necessary to take the thickness of the belt into consideration.

(354) J. S., Newark, N. J., asks: 1. What is the use of the bridge wall in the furnace of steam boilers? *A.*—The object of the bridge wall is to form a combustion chamber, so that the uncombined gases of the air and fuel may be brought by mixture into contact while still at a sufficiently high temperature for combustion. 2. When the gauge shows 80 pounds' pressure in the boiler, what mean effective pressure can we get on the piston? *A.*—That depends on the point of cut-off. The M. E. P. is generally measured from the indicator cards. 3. What is the object of stays in the steam room and water space of steam boilers? *A.*—To strengthen the boiler and prevent all undue stress on the plates of the boiler. If these stays are correctly distributed throughout the boiler, all the different parts of the boiler will be equally strong. 4. What is the temperature of the steam, when the steam gauge shows 60 pounds per square inch? *A.*—About 309.8 degrees Fahr.

(355) W. L. F., Augusta, Me., asks: Will you kindly inform me of some cement that will stick rubber to turned cast-iron? *A.*—See answer to Question 425, in the AMERICAN MACHINIST, Oct. 22, 1887.

(356) J. B. G., Carbon Hill, Ala., asks: What is the rule for finding the weight to be placed on the lever of a safety valve, to blow off at a certain pressure? *A.*—See AMERICAN MACHINIST of Dec. 6, 1884.

(357) H. R., St. Louis, Mo., sends us an example for finding the position of the weight on a safety valve lever, and asks us to state whether his solution of the problem is correct. *A.*—Yes. We have answered this question by mail, but it failed to reach you.

(358) G. L., Allegheny, Pa., writes: Would you please inform me of some good work on hydraulics—one suitable for an engineer of a steel works, pertaining to the construction of hydraulic cranes, accumulators, etc.? *A.*—You may find the information you are seeking, in the work on "Hydraulic Power and Hydraulic Machinery," by Henry Robinson.

(359) E. H. W., Kansas City, Mo., writes: We had a dispute as to the center of a revolving shaft. I claim when a shaft revolves its true center is at a standstill; for if it still revolves it certainly must not yet be its center. Would you kindly give your opinion? *A.*—Every point in a revolving body must be in motion, therefore a point in the center of the same body cannot stand still, but will move about itself.

(360) R. W., Philadelphia, Pa., asks: What is meant by the leading side of a locomotive? *A.*—The term "leading side of a locomotive" is generally applied to the right-hand side of the engine, because the crank on the right-hand side when the engine is going ahead leads, or goes ahead of the crank on the left-hand side. 2. If the wheels were taken out from under the locomotive, how could you tell the leading side by the wheels? *A.*—Unless prevented by an unequal wear, either one of the wheels can be put under the right hand side, or the so-called leading side of the engine. There is no leading side to the wheels.

(361) E. L. M., Sherbrooke, Canada, writes: We have an argument about balancing engines. A claims that to balance an engine correctly (horizontal engine) the piston, crosshead and connecting-rod should be hung on the crank and the whole amount balanced. B claims that it is only necessary to do it that way for upright engines, but for horizontal engines only a part of the weight of the connecting-rod should be balanced. Which is right? *A.*—See Article on Balancing the Running Parts of Steam Engines, by J. C. Hoadley, AMERICAN MACHINIST, Nov. 29, 1884.

(362) J. W., Pittston, Pa., sends us a description of an engine of peculiar construction. The engine is manufactured by Gohlis, Leipzig. Our correspondent asks us to explain the principles upon which the engine works, so as to enable him to meet with better success than heretofore in making a similar engine to work satisfactorily. *A.*—We have never seen an engine of the kind mentioned, and are not acquainted with its principles, and therefore cannot advise how to overcome the trouble. If you send us a drawing of the engine, we may be able, and will be glad to help you.

(363) W. J. B., Brooklyn, N. Y., writes: 1. I have heard it stated that the longer the handle of a screw-driver the greater the power that can be applied by its use. Is it so? *A.*—It is not so if the screw-driver is held straight in line with the screw. If it were to be deflected to one side, it might then act as a lever, the effect of which would depend somewhat upon its length. 2. How can I learn photography without an instructor, and what would an outfit for a beginner cost? *A.*—The outfit will cost from $10 to $100, according to quality and quantities. By writing to the makers of such outfits you will get descriptions and prices, and also can obtain of them full instructions in their use, after which it is a matter of skill and practice.

(364) M. S. & Co., ———, ask: 1. What is th best and quickest way of making spiral-springs from 2″ to 3″ diameter, about 12″ long, of iron wire, from No. 15 to 17? We tried to make them on a mandrel with a thread cut on it, but that is very slow. *A.*—A speed lathe and an arbor properly managed is not, we think, a *very* slow method of making such springs, but the best way is to use a special machine for the purpose. Such machines can be obtained of regular builders. 2. What is the best fixture to put on the bundle to prevent the wire from becoming entangled? *A.*—Put the coil of wire upon a reel, which will freely turn, and raised from the floor enough so that the wire will pull off straight. 3. What is the best thing for varnishing a machine so as to have a nice smooth varnish, which will dry quickly? *A.*—The best thing for this is to get the advice, if not the services of a competent painter.

(365) G. W., Waukesha, Wis., writes: If all the gain (given in your answer to my Question 139) to be obtained by compounding is ½ inch in the diameter of the high pressure cylinder, it will be more than lost in condensation and expense and weight of an extra cylinder, steam jackets, etc. As you say nothing about stroke of piston, and I mentioned that stroke and cut-off were to be the same, I infer that each cylinder of the compound is 60 inches stroke. *A.*—Your question led us to believe that the stroke could not be changed, and therefore the stroke of each cylinder in the compound engine is 60 inches, as you correctly infer. But the steam in the compound engine is cut off sooner, so as to obtain about 12 expansions. The aim in adopting a compound engine is not to reduce the diameter of the cylinder, but to obtain the greatest economy of fuel, which you do not seem to consider.

(366) E. I., Philadelphia, Pa., writes: 1. Please inform me how to figure out the formula to proportion a bolt 4¼″ diameter; also its head and nut. I have the formula, but wish to see it figured out. *A.*—The width of the head across the sides would be, for a rough head, 1½ times 4¼″ + ⅛″, which would be 6½″. If finished it would be 1-16″ less. The thickness of the head equals one half this, 3¼″. The width of the nut will be the same as the head, and its thickness will equal the diameter of the bolt, 4¼″. Such a bolt if standard, will have 2⅞ threads per inch, and a diameter at root of thread of 3.825″. 2. What is the difference and how do you choose a file for steel, iron, or brass? *A.*—There is practically no difference in the files. The same file may be used for either purpose, but cannot be used for brass after having been dulled by use upon the other metals, and in fact it is better in practice to have separate files for each of the different metals; though the files may be originally just alike, with the exception that for simply removing stock from tool steel by filing, it is not advantageous to use as coarse files as may be used to advantage upon softer metals.

(367) Ned, ———, writes: We have an argument relating to the size of steam chest. The steam chest cover is 4 inches from the back of the valve (an ordinary D valve). B got it into his head that there was too much space between the valve and steam chest cover, and that the steam in this space would expand and be lost in the cylinder. He said that the nearer you could get the size of the chest to that of the steam pipe the better. To reduce the space between the steam chest cover and the back of the valve he bolted a box inside the cover, making a steam-tight joint. Now, was there anything gained by the use of this box? *A.*—There is nothing gained by the use of this box. The idea that the steam in the chest will expand and be lost is incorrect. Only the steam in the cylinder and in the steam port will expand; during the time that expansion takes place, the steam in the chest will attain its maximum pressure. In connection with this subject we may state that it is always advisable to make the steam chest as small as possible, so as to reduce its outer surface and prevent the loss of heat by radiation; a small steam chest is also advantageous in engine which must be stopped quickly, because the smaller the steam chest the less steam will have to be worked off in stopping the engine, and consequently the engine can be stopped quicker with a small steam chest than with a larger one.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

See Grant's Gear advt. on back page.

Link-Belting.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link Belt Machinery Co., Chicago and N. Y.

See our new designed engine lathes in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed drill presses in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed shapers in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed brass working tools in Cincinnati Centennial Exposition. Lodge, Davis & Co.

2,000 feet of space in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See special ads. pages 15 and 16, Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee, Falls Mass.

Machine work and pattern making. Anderson Machine Works, Peekskill, N. Y.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon. 24 Columbia st., New York Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"Swift" Sight-feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Brown & Sharpe Mfg. Co., have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Patents—Whittlesey & Wright, 705 8th st., N. W., Washington, D.C. Send for pamphlet and references.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Mech'l drawings, mach. patterns & models. Inventors' ideas perfected. J. Valentine, 15 Alling st. Newark, N. J.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co. 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row. N. Y.

Machinists' supplies, brass goods, m'f'rs supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

Patent Attorney. R. G. DuBois, 916 F. st., Washington, D. C. Service at reasonable rates. Send for pamphlet containing list of references.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See July 7, p 12. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Upright drills, improved, sizes 21″, 23″, 25″, 28″, 32″, 36″ swing; finely made and great capacity; write for cuts and prices. Currier & Snyder, Worcester, Mass.

W. H. Hoffman, consulting engineer. 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Parties requiring milling machine or screw machine work furnished, in large or small quantities, please write to the manufacturers, E. E. Garvin & Co., 139, 141, 143 Centre st., New York City.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

A practical treatise on the steam engine, by Arthur Rigg, essays on the principles involved in design and construction of fixed engines; 312 pages, with 96 plates. 4to. cloth, $10.00. E. & F. N. Spon, 12 Cortlandt st., N. Y.

For the manufacture of
Patented articles in line of machine work;
Specialties in fine light machinery;
Accurate cam cutting;
Address Wardwell S. M. Co., Woonsocket, R. I.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G Co., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including June 30, 1888 issue, 53 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 68 articles have thus far appeared up to and including the July 7, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York

MANUFACTURES

The Norfolk (Va.) Fuel and Gas Light Company will put up a plant.

Rogers Brothers are building a furniture factory at Daw's Station, Tenn.

R. P. Rowell is interested in building a woolen factory at Barnesville, Ga.

The San Antonio (Texas) Foundry Company will increase its capital stock.

J. D. Noble, Anniston, Ala., will put additional machinery in their boiler works.

The Keene, N. H., Gas and Electric Light Company intends to add an incandescent plant.

The Laclede Gas Light Company, St. Louis, Mo., propose putting up a plant for electric lighting.

The Delaware Edison Illuminating Company, of Delaware, O., has organized with a capital stock of $50,000.

The Standard Foundry Company, St. Louis, Mo., are increasing their facilities for making standard pulleys.

The city authorities of St. Louis, Mo., are agitating the question of the city making and supplying the gas used.

The Wyeth City Canning Company has been chartered to start a fruit and vegetable canning factory at Guntersville, Ala.

Jones Bros. will erect a planing mill and a sash, door and blind factory at Columbus, Ga. They will employ from 75 to 100 hands.

The Thomson-Houston Electric Light and Power Company, of Hempstead, N. Y., has been incorporated. Capital stock, $75,000.

The Mather-Tucker Electric Company, of Jersey City, N. J., has just been incorporated by H. G. Cheney and others. Capital stock, $350,000.

The contract has been let for building the machine shop and foundry for Flynn & Emerich, of Baltimore, Md. The building will be five-story, and 58 x 125 feet.

The American Gas Saving Company, 773 Broadway, N. Y., send us their latest circular of gas-saving appliances, consisting of burners, governors, gauges, etc.

The Baldwin Locomotive Works, of Philadelphia, have received an order from the Northern Pacific for the construction of fifty locomotives. This speaks well for the increasing business of the Northwest.

A stock company with a capital of $1,000,000 has been organized at Owosso, Mich., to manufacture the Stevens patent car axle oiler. J. W. Begole, of Flint, is president of the corporation, and Arthur Stevens, secretary.

The new factory of the Curtis & Co. Manufacturing Company, at 1133 North Second street St. Louis, Mo., is now in full operation in all parts, barring the machine shop, for which new tools are still arriving. Two Bickford drill presses for this department came in this week, and the arrival of a large iron planer, bought through Hill, Clarke & Co., is momentarily expected.

The Kansas City (Mo.) Foundry and Machine Company, which lately bought out the King Novelty Manufacturing Company, of Independence, has now fully organized, with capital stock of $40,000 paid up. T. B. Ray, president; T. C. Bradley, vice-president and treasurer. They are now building a new brick foundry and machine shop at Manchester, a suburb of Kansas City, and expect to be in active operation by August 1.

Hill, Clarke & Co., Boston, Mass., report business brisk in the sale of machine tools. Amongst a large number of orders recently received is one for a complete outfit, consisting of brass finishing lathes, monitor brass lathes, engine lathes, milling machines, upright drills, etc., from the Martin Anti-Fire Car Heater Company, Dunkirk, N. Y.; also an outfit for the Chicago, Burlington & Quincy R. R., for their shops at Plattsmouth, Neb.

There is water-works agitation at Brooklyn, N. Y.; Superior, Wis.; Oberlin, Kan.; Fernandina, Fla.; Eustis, Fla.; Fort Valley, Ga.; Wellston, Ohio; Aroostock, Maine; Narragansett Pier, R. I.; Owosso, Mich.; Oxford, N. C.; Windsor, Can.; Anita, Iowa; Republican City, Neb.; Gladwin, Mich.; Whitney, Neb.; Jefferson, Iowa; Fairport, N. Y.; Hinesville, Ga.; Berkley, Va.; Wakefield, R. I.; Vermillion, Dak.; River Point, R. I.

The United Electric Light Company, of Springfield, Mass., will move from its present place of business on Taylor street to the foot of State street, where it will erect a building 110 ft. x 115 ft., which is intended to be fire-proof. A considerable increase will be made in dynamo capacity, which now consists of two 20-light Thomson-Houston arc machines, four 45-light divided arc machines of the same system, one Thomson-Houston motor generator, and three 650-light Westinghouse alternating dynamos. The new plant will probably be ready by September.

According to the Kansas City (Mo.) *Commercial*, a large rolling mill will be located in Armourdale in the future, but the names of the capitalists backing it have thus far been withheld from the public. The plant will employ about 250 men, and a large amount of capital will be invested in it. It will be located at the foot of Thirteenth street and Pony avenue, on the line of the Belt Line road. The ground secured for the plant extends back to the Kaw river. It is rumored that the new company has purchased much of the machinery of the old Rosedale rolling mills. The machinery is very valuable, and has been carefully guarded for five or six years, or ever since the Rosedale rolling mills went into bankruptcy.

Ground was broken Monday morning by Messrs. Turner, Dickinson & Co., for their new foundry plant in the northwest part of Chicago at the corner of Hoyne avenue, Churchill and Bloomingdale streets. The firm will at once build one of the most complete plants for heavy foundry work that there is in the city. Their main building will be 100 by 131 feet, two stories high, with a truss roof, leaving the interior floor space perfectly clear and without pillars. A second building for finishing and cleaning the castings, etc., will be 40 x 160 feet. In addition to their present melting apparatus, which they will move from their foundry on Twentieth street, they will put in a new 20-ton cupola, thus giving them a large melting capacity. The power will be furnished by a 75 horse-power Buckeye automatic engine, just purchased. The location of the new plant is very favorable, as it is on the Pacific Division of the Milwaukee and St. Paul Railroad, and the arrangement of the buildings will be such as to facilitate the operation of the plant with the minimum amount of labor. At their old foundry on the south side Messrs. Turner, Dickinson & Co. labored under many disadvantages, notwithstanding which they have built up a fine business and have gained the confidence of a high class of trade.—*Industrial World.*

A correspondent writes us: Freeport, Ill., is still growing. The canning factory built and operated by Messrs. Emery & Keene burned down last winter. This spring Mr. Emery associated himself with Mr. Williams, and they are building a factory near the old site. Mr. Keene and J. D. Diffenbaugh & Son have formed a company, and are building a factory on the west side of the river. The Henny Buggy Company, whose shops now cover about half a block, are going to enlarge, and will put up an addition 60 by 120 feet, five stories, 80 feet high, of red brick and terra cotta, with galvanized iron cornice and plate glass fronts. The offices of the company will be in this building: also a vault 9 by 17 feet. The Stover Manufacturing Company, who built a large foundry for light grey iron castings last fall, are building a new machine shop and foundry for heavy castings near their present foundry. When completed the works will consist of a main building 458 by 250 feet, a wing 110 by 40 feet, and an ell 58 by 140 feet; also a light casting foundry 60 by 250 feet. Two tracks run in from the railroad. J. L. Robinson, who makes a specialty of spring wagons, has rented the old Stover shops, and will largely increase his business. The Freeport Hardware Manufacturing Company, who make a specialty of spring hinges, are compelled to have more room. They have purchased a lot and begun erecting shops, and have since bought an adjoining lot with large buildings, which with what they are erecting, will give them ample room, with splendid shipping facilities, as it extends up to the railroad track.

Machinists' Supplies and Iron.

NEW YORK, July 12, 1888.

Iron—American Pig—We quote Standard Lehigh and North River brands $17.50 to $18.50 for No. 1 X Foundry; $16.50 to $17.50 for No. 2, and $15 to $16 for Grey Forge. Outside brands are offering at lower prices.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to examine S. S. planes; see p 11.

A mechanical draftsman, with experience, wants a position. Address F. D., AM. MACHINIST.

A mech'l draftsman, graduate from a polytechnic school, wants position. Address W. K., AM. MACHINIST.

Experienced mech'l draftsman (shop tools, special machinery,) is open to engagement from Sept. 1st next; best of ref. Address BOX 1, AM. MACHINIST.

General mach. shop foreman desires to change situation; been with present employers 9 yrs; age 32; strictly temperate; A1 ref. BOX 3, AM. MACHINIST.

A designer and draftsman wants a situation; is graduate from technical school, and has experience as machinist. Address K., AM. MACHINIST.

Wanted—A practical designer and draftsman, to make new drawings for automatic and plain slide valve engines. Address Shop, AM. MACHINIST.

Wanted—Situation as foreman boiler maker by a practical man on all classes of work; 11 years' experience; good references. O. K., AM. MACHINIST.

A man with 14 years' experience on general machinery, is a designer and can handle men, indoors or out, wishes an engagement where push will be rewarded. Address No. 33, AM. MACHINIST.

Wanted—Position by mechanical engineer; good draftsman; exp. in hoisting, dredging, and pile driving machinery; best of European ref. Address F. M. Hulswit, 157 Monroe st., Grand Rapids, Mich.

Wanted—A foreman to take charge of a small machine tool works, working about 20 men; must be well up in all the requirements of the position; state age, references and wages expected; young man preferred. Box 2, AM. MACHINIST.

Wanted—Position as foreman boiler maker, by a competent man who has had a large experience in all kinds of work from marine to locomotive, and can give reference as to ability, etc. J. W. T., AM. MACHINIST.

Wanted—A practical foundry foreman, by a car manufacturing company; to satisfactory man fair wages and steady employment will be assured. Address, giving references and stating experience and salary desired, M. D., AM. MACHINIST.

Wanted—A thoroughly competent salesman well posted on iron-working and wood-working machinery, steam engines and boilers, steam pumps, etc.; good salary and permanent position for right man. Address John R. Wilberton, P. O. Box 16, Portland, Oregon.

Wanted—For good permanent position, a good man thoroughly experienced in the different branches of fine machine work and tool making; one having knowledge of drafting preferred. Address, stating age, etc., Charles Hutchinson, Detroit Electrical Works, Detroit, Mich.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head a 35 cents per line, each insertion.

Crescent Boiler Tube Expander; second to none; price in reach of all. Crescent Mfg. Co., Cleveland, O

The Crescent Link Belt Coupling; something new; sample free. Crescent Mfg. Co., Cleveland, O.

Wanted—Special machinery to build; correspondence solicited. F. D. Butricks, New Haven, Conn.

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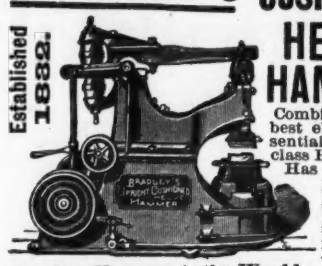

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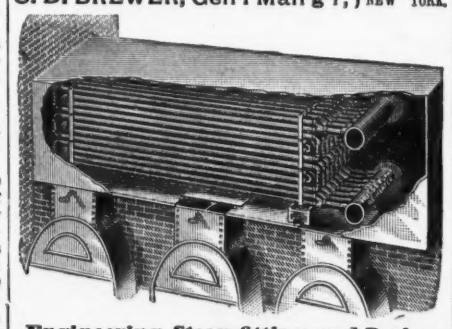

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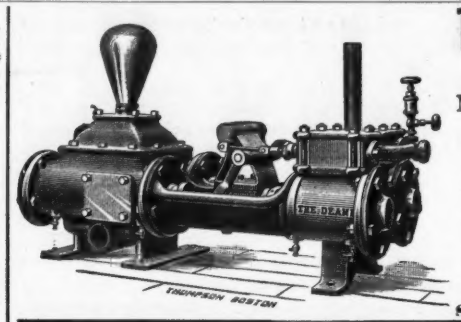

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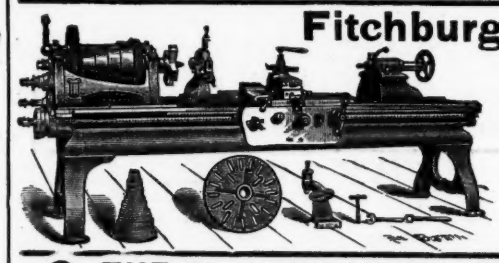

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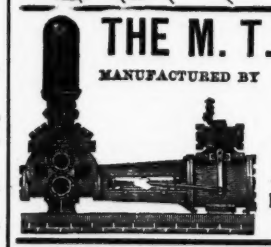

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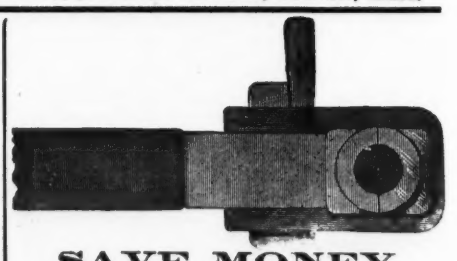

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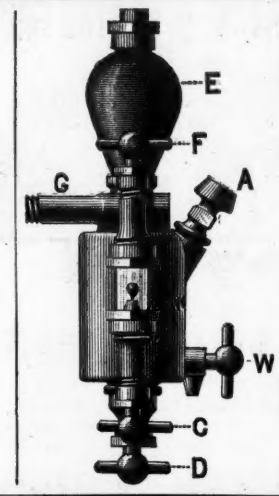

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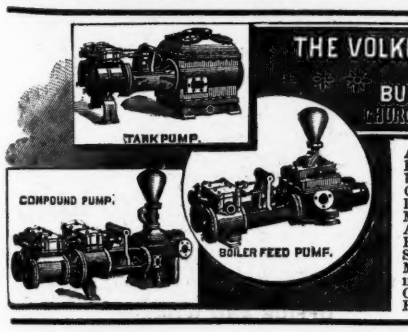

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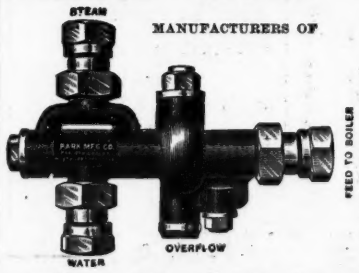

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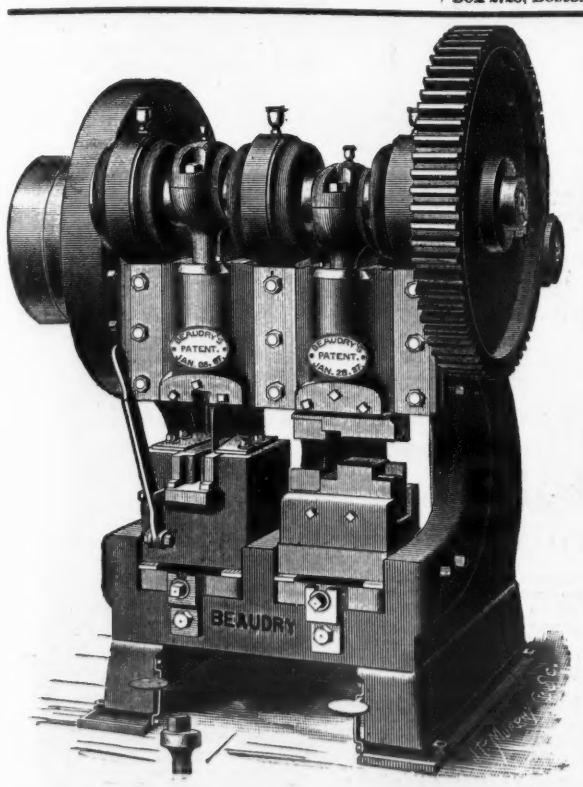

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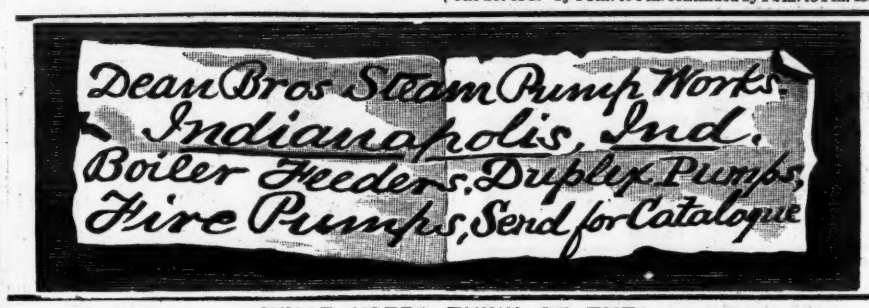

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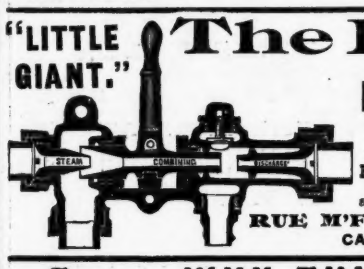

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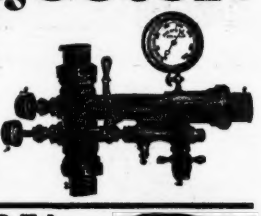

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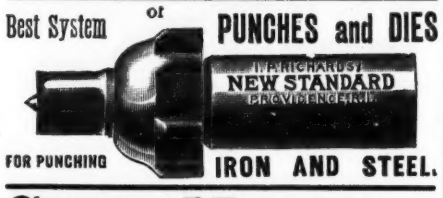

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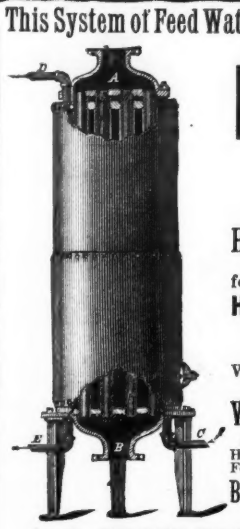

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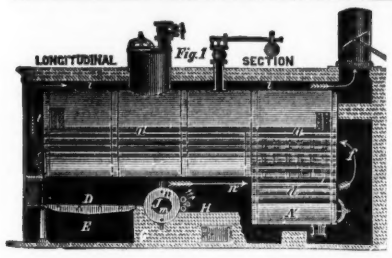

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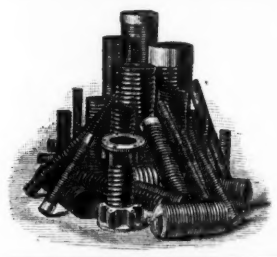

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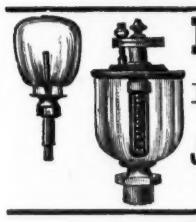

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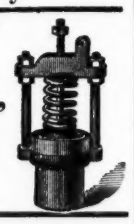

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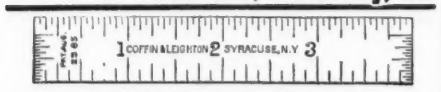

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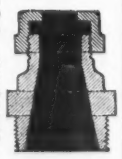

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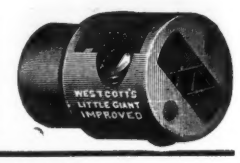

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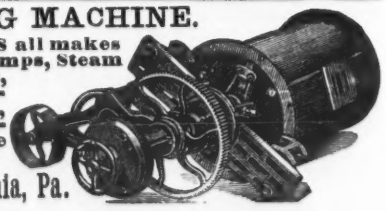

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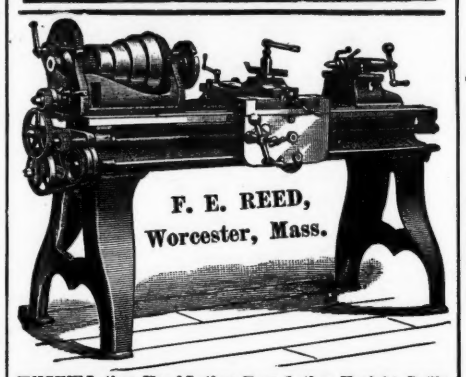

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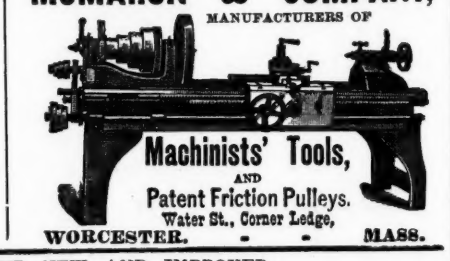

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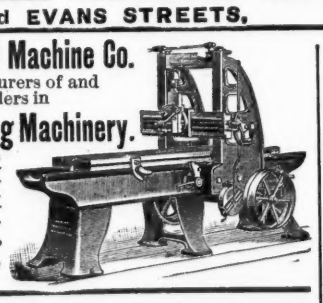

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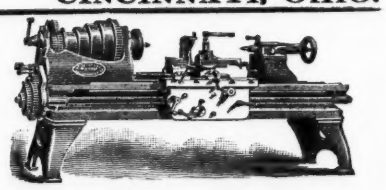

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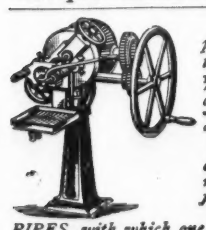

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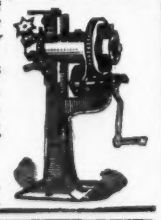

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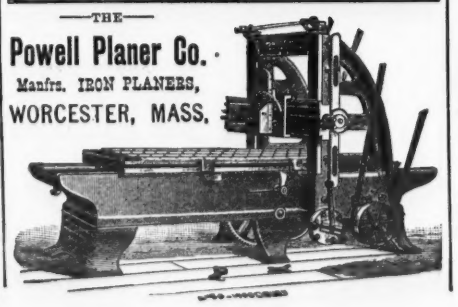

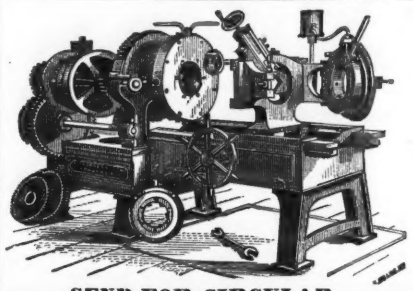

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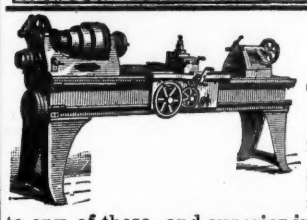

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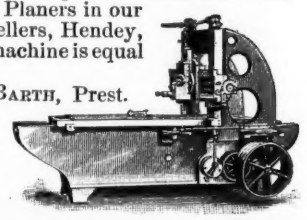

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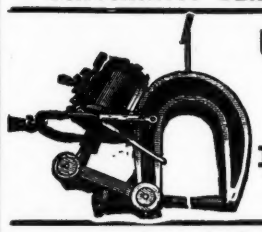

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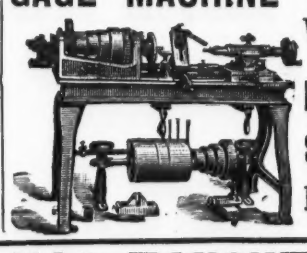

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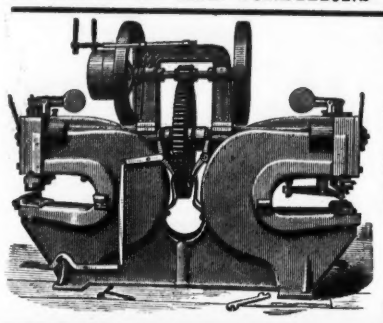

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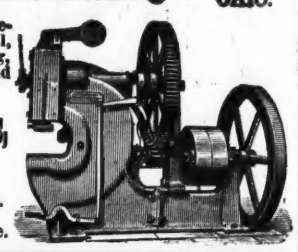

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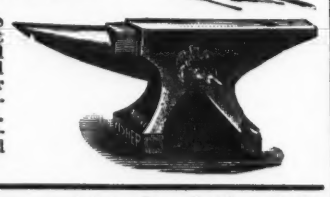

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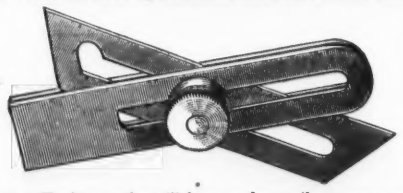

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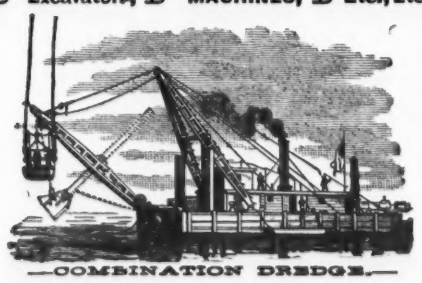

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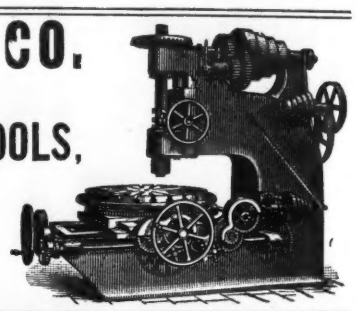

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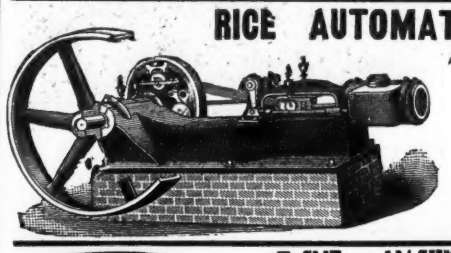

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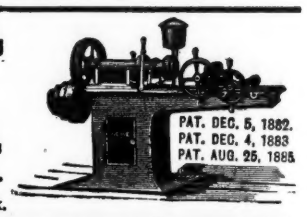

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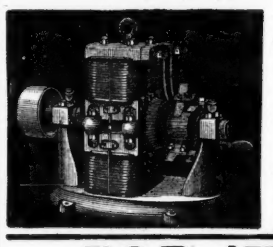

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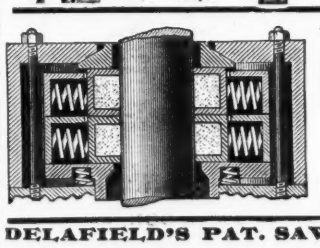

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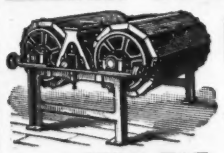

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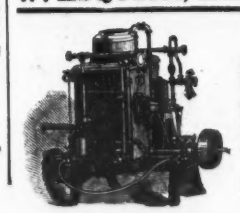

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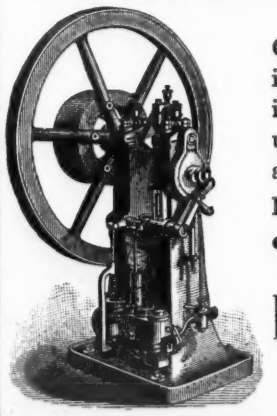

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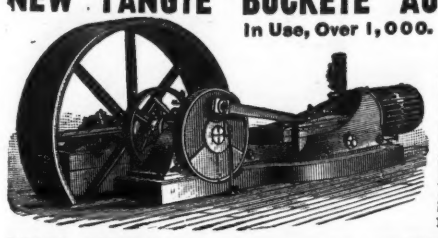

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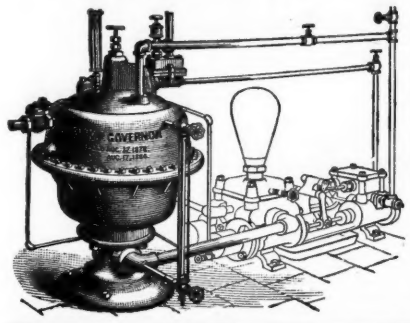

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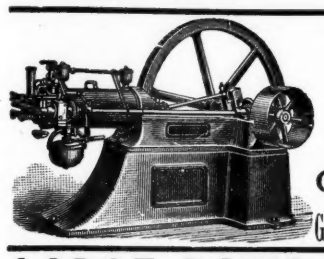

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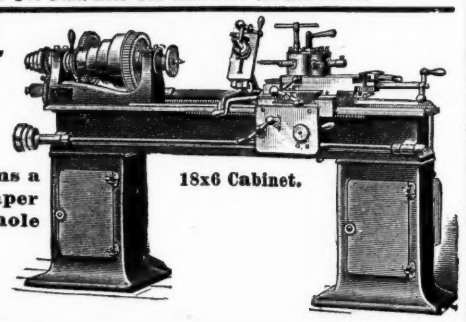

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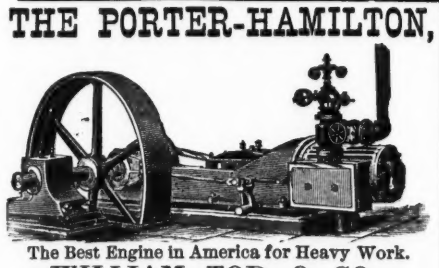

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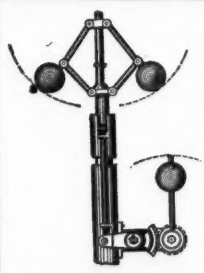

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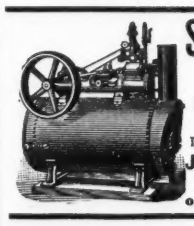

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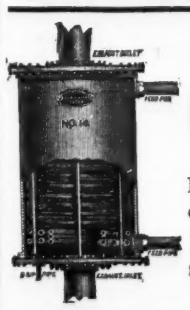

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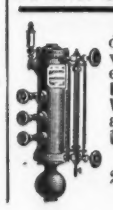

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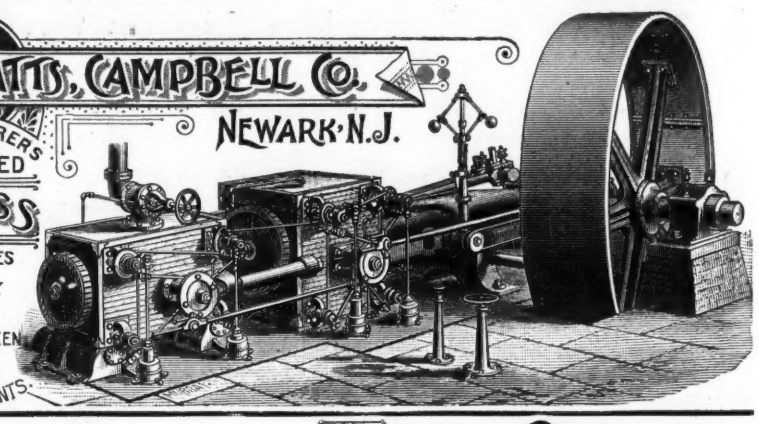

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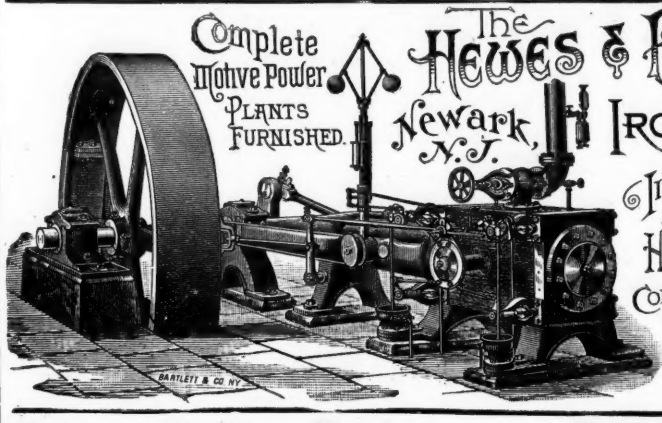

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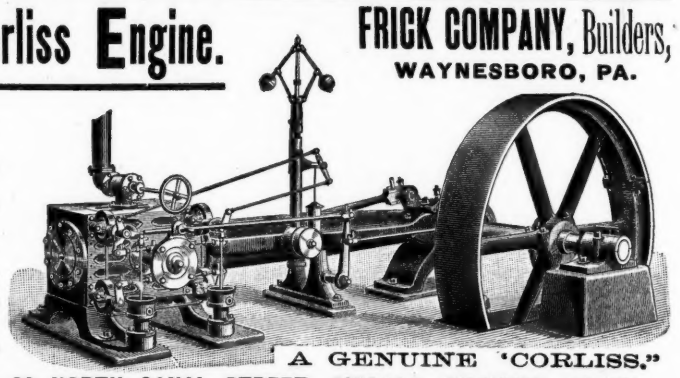

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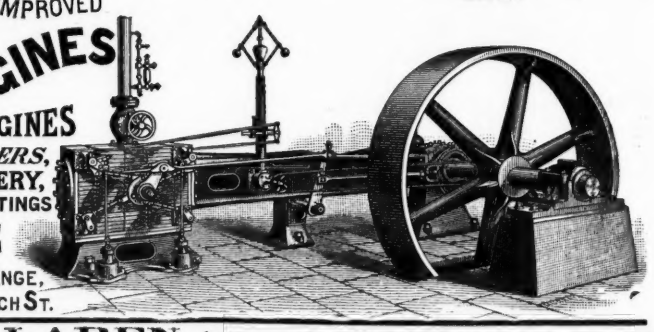

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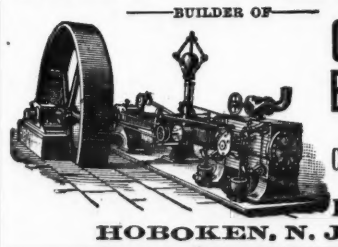

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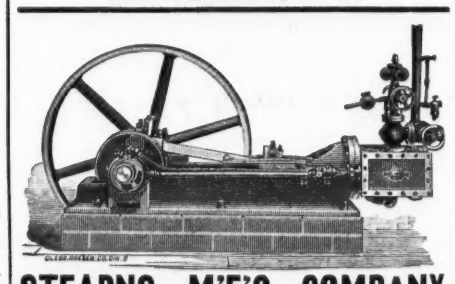

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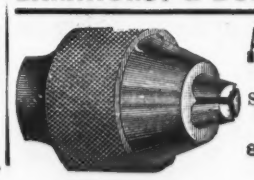

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18 "	"	8 "	"	"	"		Fifield.
18 "	"	7 "	"	"	"		D. W. Pond.
17 "	"	5½ "	"	"	"		Shepard.
15 "	"	6 "	"	"	"		Fitchburg.
12 "	"	5 "	"	"	"		Prentice.
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Monitor Brass Lathe, 18 in. swing, 5 ft. bed.							
Amoskeag Planer, planes 18 in. wide, 3 ft. long.							
Wheeler	"	"	22 "	"	4 "	"	
Providence	"	"	24 "	"	5 "	"	
Hendey	"	"	26 "	"	6 "	"	
Bement	"	"	30 "	"	8 "	"	
New Haven	"	"	36 "	"	10 "	"	
Hendey Shaper. 24 in. stroke. Fine condition.							
Wiley and Russell Bolt Cutter No. 5, cuts ⅜ to 1¼"							
Brainard Gear Cutter, 30 in. Automatic Feed.							
Garvin No. 2 Gang Drill, 2 spindles.							
" " 4 "			4 "				
Pratt & Whitney Vertical Tapping Machines.							
"		2½ in. Cutting-off Machine.					
Betts'		4 "	"	"			

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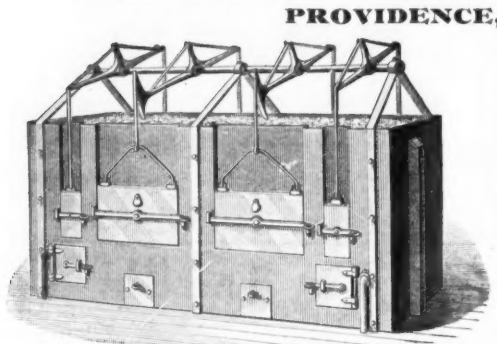

These Furnaces were designed for the expeditious and economical annealing of cast iron or steel, and have proved entirely satisfactory, several of them having been in use for a number of years. We make two sizes, which are similar in construction, consisting of iron plates to enclose the necessary space, which serve also as guides for the doors, which are raised perpendicularly (except the oven doors for the large furnace, which swing by means of a lever), and are balanced by a weight at the back of the furnace. The separate plates are held together by bolts, and also tie-rods extending through the brick work longitudinally and transversely. The inside of furnace consists of fire space and the oven proper, an arch extending over both, the fire space being separated by a bridge wall extending nearly to arch, leaving only a narrow space through which the flame is forced by the blast, completely filling the oven, the escape of gases being through small outlets in the corners to the flues below, the flues being fitted with a damper operated from the front.

Oven and **Fire Doors** are lined with tiles; the oven floor is also of tiles.

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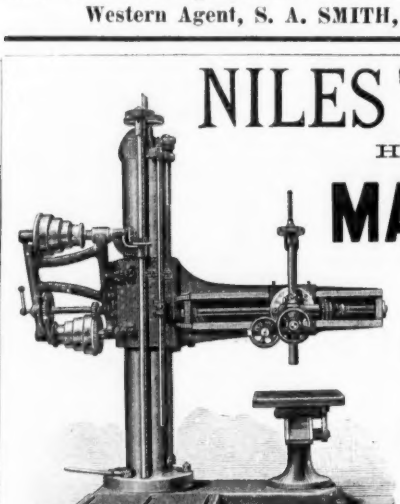

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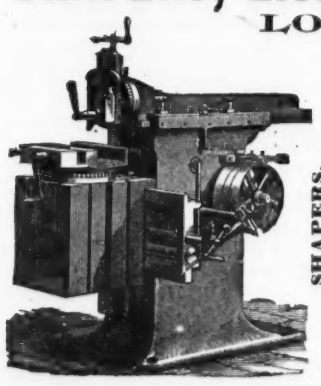

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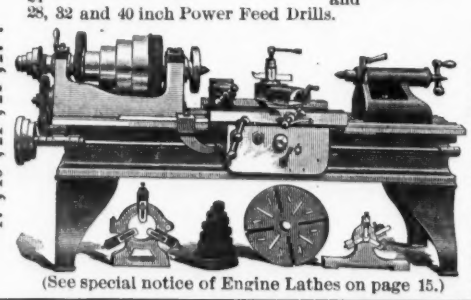

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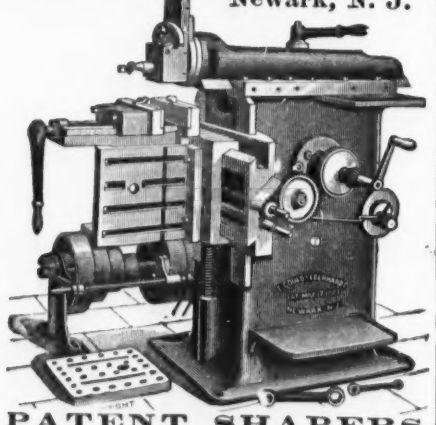

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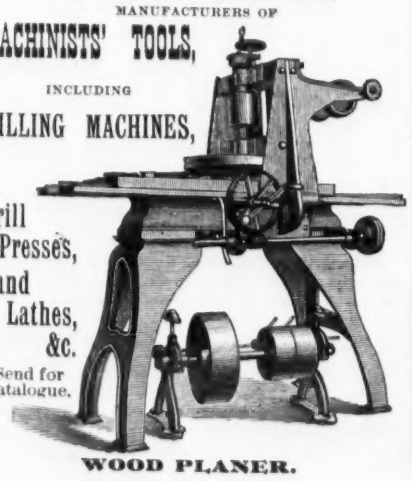

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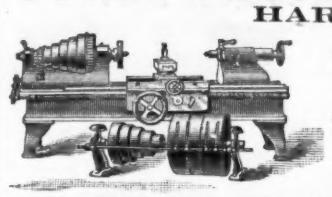

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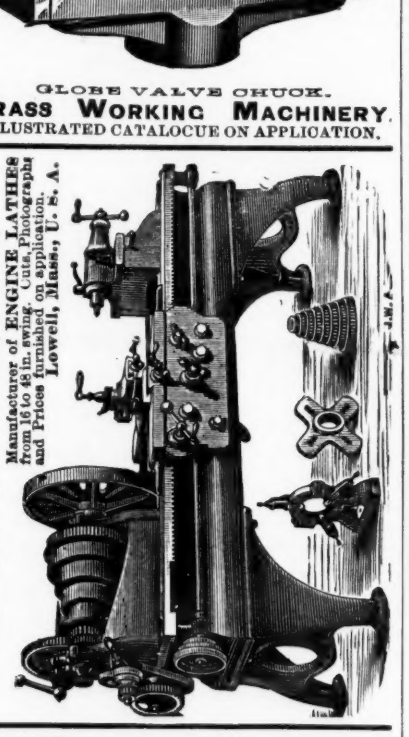

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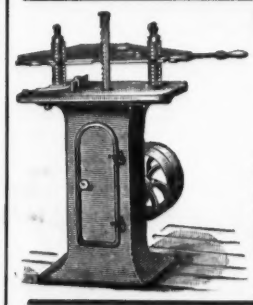

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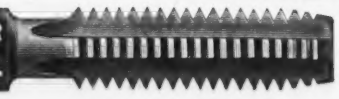

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